

**EPA Superfund**  
**Record of Decision:**

**SMITH'S FARM**  
**EPA ID: KYD097267413**  
**OU 02**  
**BROOKS, KY**  
**09/17/1993**

RECORD OF DECISION

FOR

OPERABLE UNIT TWO

SMITH'S FARM (BROOKS)

CERCLA NPL SITE

SHEPHERDSVILLE, BULLITT COUNTY, KENTUCKY

KY0972674139

SUMMARY OF REMEDIAL ALTERNATIVE  
SELECTION

AND THE

DECLARATION

U.S. Environmental Protection Agency  
Region IV  
Atlanta, Georgia

September 17, 1993

## **RECORD OF DECISION**

Remedial Alternative Selection

## **SITE NAME AND LOCATION**

Smith's Farm Site (Second Operable Unit)  
Brooks, Bullitt County, Kentucky

## **STATEMENT OF BASIS**

This decision document presents the selected final remedial action for the Second Operable Unit of the Smith's Farm Site, Brooks, Bullitt County, Kentucky, which was chosen in accordance with CERCLA, as amended by SARA, and the National Oil and Hazardous Substances Pollution Contingency Plan. This decision is based on the administrative record for the Site. Among the Administrative Record documents which form the basis for selection of the remedial action are:

- . Remedial Investigation Report, Operable Unit Two
- . Feasibility Study Report, Operable Unit Two
- . Summary of Remedial Alternative Selection
- . Responsiveness Summary
- . Staff Recommendations and Reviews

The Commonwealth of Kentucky concurs with the selected remedy.

## **ASSESSMENT OF THE SITE**

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

## **DESCRIPTION OF THE REMEDY**

The function of this remedy is to reduce the risk associated with exposure to the (1) contaminated, on-site surface soils, (2) contaminated, onsite surface and ground waters, (3) contaminated, on-site stream sediments, and (4) contaminated, on-site leachate and leachate sediments.

The major components of the selected remedy include:

- . Remediate subsurface thermal anomalies
- @ Consolidate peripheral waste areas within landfill
- . Install extensive leachate collection system to intercept and collect leachate and contaminated ground water
- . Recontour surface of landfill
- . Install RCRA-type cap with run-on and run-off control systems and a gas control system

- . Install multi-stage leachate treatment system for on-site discharge to the intermittent Unnamed Tributary east of the landfill
- . Install a perimeter fence and warning signs
- . Monitor the Operable Unit Two wells semi-annually for five (5) years after construction is complete and thereafter annually for twenty-five (25) years
- . Impose surface water and ground water use restrictions as well as deed restrictions to limit land use

#### **DECLARATION**

The selected remedy is protective of human health and the environment, attains Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. This remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element and utilizes permanent solutions to the maximum extent practicable. However, because treatment of the principal threats at the Site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment of all Site wastes as a principle element. This remedy utilizes containment due to the technical impracticability of treating a large volume of mixed, heterogeneous landfill wastes.

Because this remedy may result in hazardous substances remaining on site above health-based levels, a review will be conducted within five (5) years after the commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

**RECORD OF DECISION**

**FOR**

**OPERABLE UNIT TWO**

**SMITH'S FARM (BROOKS)**

CERCLA NPL SITE

SHEPHERDSVILLE, BULLITT COUNTY, KENTUCKY

KY0972674139

**REMEDIAL ALTERNATIVE SELECTION**

U.S. Environmental Protection Agency  
Region IV  
Atlanta, Georgia

September 17, 1993

**TABLE OF CONTENTS**

- 1.0 INTRODUCTION
  - 1.1 SITE NAME, LOCATION AND DESCRIPTION
  - 1.2 SITE HISTORY
- 2.0 ENFORCEMENT HISTORY
- 3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION
- 4.0 SCOPE AND ROLE OF THE OPERABLE UNIT WITHIN THE SITE STRATEGY
- 5.0 SUMMARY OF SITE CHARACTERISTICS
  - 5.1 ENVIRONMENTAL SETTING
    - 5.1.1 Climate.
    - 5.1.2 Flora and Fauna.
    - 5.1.3 Geology.
    - 5.1.4 Soils.
    - 5.1.5 Hydrogeology.
    - 5.1.6 Surface Water and Topography.
  - 5.2 GEOPHYSICAL INVESTIGATION RESULTS
    - 5.2.1 Areal Extent of the Landfill
    - 5.2.2 Vertical Extent of Landfill.
    - 5.2.3 Landfill Characterization.
    - 5.2.4 Mapping of Subsurface Conductive Plume.
    - 5.2.5 Reconnaissance of Unnamed Tributary.
    - 5.2.6 Infrared Thermal Imagery.
    - 5.2.7 Radiological Survey.
    - 5.2.8 Summary of Results.

### 5.3 CONTAMINATION IN THE STUDY AREA

- 5.3.1 Exploratory Trenching Results.
- 5.3.2 Leachate and Leachate Sediment.
- 5.3.3 Surface Water and Stream Sediment.
- 5.3.4 Surface and Subsurface Soil.
- 5.3.5 Ground Water.
- 5.3.6 Summary of the Contamination in the Study Area.

### 6.0 SUMMARY OF SITE RISKS

#### 6.1 HUMAN HEALTH RISKS

- 6.1.1 Concentrations of Contaminants of Concern in Each Medium of Exposure.
- 6.1.2 Summary of Results of Exposure Assessment.
- 6.1.3 Summary of the Toxicity Assessment of Contaminants of Concern.
  - 6.1.3.1 Noncarcinogenic Effects
  - 6.1.3.2 Carcinogenic Effects
  - 6.1.3.3 Dermal Exposures
- 6.1.4 Summary of Risk Characterization of Each Pathway and the Total Risk for the Site.
  - 6.1.4.1 Potential or Actual Carcinogenic Risks
    - 6.1.4.1.1 Current Carcinogenic Risks for Residential Populations
    - 6.1.4.1.2 Future Carcinogenic Risks for Residential and Occupational Adult Populations
  - 6.1.4.2 Noncarcinogenic Risks
    - 6.1.4.2.1 Current Noncarcinogenic Risk
    - 6.1.4.2.2 Future Noncarcinogenic Risk for Nearby Residents, Onsite Residents, and Construction Workers
  - 6.1.4.3 Summary

#### 6.2 ENVIRONMENTAL EVALUATION

- 6.2.1 Summary of the Affects of the Contamination on Habitats.
- 6.2.2 Summary of the Affects of the Contamination on Any Endangered Species.

### 7.0 DESCRIPTION OF ALTERNATIVES

#### 7.1 ALTERNATIVE I - NO ACTION

- 7.1.1 Treatment Component.
- 7.1.2 Containment Component.
- 7.1.3 General Components.
- 7.1.4 Major ARARs.

## 7.2 ALTERNATIVE II - LEACHATE COLLECTION AND TREATMENT

- 7.2.1 Treatment Component.
- 7.2.2 Containment Component.
- 7.2.3 General Components.
- 7.2.4 Major ARARs.

## 7.3 ALTERNATIVE III - CONSOLIDATION OF LANDFILL WASTE, CAP AND COVER, LEACHATE COLLECTION AND TREATMENT

- 7.3.1 Treatment Component.
- 7.3.2 Containment Component.
- 7.3.3 General Components.
- 7.3.4 Major ARARs.

## 7.4 ALTERNATIVE IV - STABILIZATION OF LANDFILL ANOMALIES, CONSOLIDATION OF LANDFILL WASTE, LEACHATE COLLECTION AND TREATMENT, CAP AND COVER

- 7.4.1 Treatment Component.
- 7.4.2 Containment Component.
- 7.4.3 General Components.
- 7.4.4 Major ARARs.

## 7.5 ALTERNATIVE V - INCINERATION AND STABILIZATION OF LANDFILL ANOMALIES, CONSOLIDATION OF LANDFILL WASTE, LEACHATE COLLECTION AND TREATMENT, CAP AND COVER

- 7.5.1 Treatment Component.
- 7.5.2 Containment Component.
- 7.5.3 General Components.
- 7.5.4 Major ARARs.

## 7.6 EXPLANATION OF MAJOR APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED STANDARDS

### 7.6.1 Chemical-specific ARARs.

- 7.6.1.1 Soil and Sediment
- 7.6.1.2 Water
- 7.6.1.3 Air

### 7.6.2 Location-specific ARARs.

### 7.6.3 Action-specific ARARs.

### 7.6.4 Major State ARARs.

### 7.6.5 To-Be-Considereds (TBCs).

## 8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

## 8.1 THRESHOLD CRITERIA

### 8.1.1 Overall Protection of Human Health and the Environment

### 8.1.2 Compliance With ARARs.

## 8.2 PRIMARY BALANCING CRITERIA

### 8.2.1 Long-Term Effectiveness and Permanence.

### 8.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment.

### 8.2.3 Short-Term Effectiveness.

### 8.2.4 Implementability.

### 8.2.5 Cost.

## 8.3 MODIFYING CRITERIA

### 8.3.1 State/Support Agency Acceptance.

### 8.3.2 Community Acceptance.

## 9.0 THE SELECTED REMEDY

### 9.0.1 Treatment Components.

### 9.0.2 Containment Components.

### 9.0.3 General Components.

## 9.1 REMEDIATION LEVELS AND OBJECTIVES

### 9.1.1 Buried Waste and Fill Material.

### 9.1.2 Leachate Water and Very Shallow Ground Water.

### 9.1.3 Surface Water and Surface Water Sediments.

### 9.1.4 Landfill Thermal Anomalies.

### 9.1.5 Metallic Anomalies Near the Unnamed Tributary.

## 9.2 STATUTORY DETERMINATIONS

### 9.2.1 Protection of Human Health and the Environment.

### 9.2.2 Compliance With Applicable or Relevant and Appropriate Requirements (ARARs).

#### 9.2.2.1 Resource Conservation and Recovery Act (RCRA)

#### 9.2.2.2 Clean Air Act (CAA)

#### 9.2.2.3 Ground Water/Surface Water ARARs

### 9.2.3 Cost-Effectiveness.

### 9.2.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable.

### 9.2.5 Preference for Treatment as a Principal Element

## 9.3 DOCUMENTATION OF SIGNIFICANT CHANGES

## 10.0 THE RESPONSIVENESS SUMMARY

### 10.1 OVERVIEW

### 10.2 BACKGROUND ON COMMUNITY INVOLVEMENT

### 10.3 MAJOR PUBLIC COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND EPA RESPONSES TO THOSE COMMENTS

## FIGURES

- 1.0 -- Site Location Map
- 1.1 -- Site Map Depicting Two Operable Units
- 5.1 -- Conceptual Hydrogeological Model
- 5.2 -- Portion of the U.S.G.S. Brooks 7.5-Minute Quadrangle
- 5.3 -- Interpreted Areal Limit of Landfill Material Based on Geophysical Data
- 5.4 -- Isopach Map of Landfill Material
- 5.5 -- Pre-Landfill Topographic Surface
- 5.6 -- Map of EM-31 Apparent Conductivity
- 5.7 -- Infrared Thermal Imagery Map
- 5.8 -- Leachate and Leachate Sediment Analytical Data
- 5.9 -- Surface Water and Stream Sediment Analytical Data
- 5.10 -- Surface and Subsurface Soil Analytical Data
- 5.11 -- Monitoring Well Analytical Data
- 9.0 -- Areas of Suspected Contamination Outside the RCRA Cap
- 9.1 -- Conceptual Leachate Collection Plan

## TABLES

### Table

- 2.0 -- Smith's Farm Site - Remedial History
- 5.0 -- Smith's Farm - Operable Unit Two RI - Waste Inventory
- 5.1 -- Summary of Concentration Ranges of Chemicals of Concern by Media
- 5.2 -- Estimated Exposure Point Concentrations
- 6.0 -- Exposure Routes Considered
- 6.1 -- Major Assumptions About Exposure Frequency and Duration
- 6.2 -- Chronic Health Criteria for Chemicals of Concern
- 6.3a -- Summary of Noncarcinogenic Risks - Current and Future
- 6.3b -- Summary of Carcinogenic Risks - Current and Future
- 6.4a -- Summary of Major Site Risks Based on Current Land Use
- 6.4b -- Summary of Major Site Risks Based on Future Land Use
- 6.5 -- Comparison of Surface water Concentrations (95% UCL) to Water Quality Criteria for the Protection of Aquatic Life
- 6.6 -- Comparison of Sediment Quality to Concentrations Found in the Unnamed Tributary's Sediments
- 8.0 -- Description of Five Alternatives
- 9.0a -- Action Levels for Surface Solids and Leachate Sediment for Landfill Consolidation
- 9.0b -- Action Subtotals for Landfill Consolidation
- 9.0c -- Remediation Levels for Ground, Surface, Leachate Water
- 9.1 -- ARARs and TBCs for the Selected Remedy

## ATTACHMENTS

- 5.0 Summary Tables of Analytical Results from the Operable Unit Two Remedial Investigation
- 5.1 Analytical Data from Sampling of the Unnamed Tributary
- 7.0 Summary of Costs for Remedial Actions Alternatives
- 7.1 Leachate Collection and Physical Treatment
- 7.2 Collection and Chemical/Physical Treatment and Heavy Metals Removal
- 7.3 Leachate Collection and Chemical/Physical Treatment for the Removal of Heavy Metals and Organics
- 7.4 Leachate Collection and Chemical/Physical/Biological Treatment for the Removal of Heavy Metals and Organics
- 7.5 Leachate Interceptor Trench Typical Detail
- 8.0 Letter of Concurrence from Commonwealth of Kentucky
- 9.0 Determination of Action Levels in Tables 9.0a, 9.0b, 9.0c
- 10.0 Transcript of May 21, 1992 Public Meeting, Proposed Plan Presentation, and List of Attendees

## 1.0 INTRODUCTION

### 1.1 SITE NAME, LOCATION AND DESCRIPTION

The Smith's Farm Site refers to an approximately 460-acre property located in a rural part of Bullitt County, Kentucky, approximately 1.5 miles southwest of Brooks, Kentucky. The Site is located at an approximate latitude of 38 degrees 2 minutes 45 seconds and a longitude of 85 degrees 44 minutes 0 seconds (See Figure 1.0.). The Site is bordered on the north, east, and west by forested hills and on the south by a residential area along Pryor Valley Road. The Site includes an area of approximately eighty (80) acres where unpermitted disposal of drums occurred over a thirty (30) year period. This area, which is being addressed in Phase One or Operable Unit One, was the subject of a prior Remedial Investigation /Feasibility Study (RI/FS) funded by the USEPA, a Record of Decision (ROD) dated September 29, 1989, and a ROD Amendment dated September 30, 1991. The Site also contains a landfill of approximately 37.5 acres (See Figure 1.1.) which was permitted for inert industrial wastes by the Commonwealth of Kentucky. Phase Two or Operable Unit Two addresses the formerly permitted landfill as well as several smaller outlying disposal areas. A major intermittent tributary, the Unnamed Tributary, of Bluelick Creek and the Floyd's Fork stream system runs from the northernmost portion of the Smith's Farm property to the southernmost edge of that property and then off-site into Bluelick Creek. The Unnamed Tributary drains both major disposal areas.

At the southeast edge of the landfill along the access road there are several small run-down wooden buildings, one of which houses an inoperative electric pump and collection sump which are a part of the old leachate collection and recirculation system. The other buildings in that same area served as equipment maintenance and storage structures. In the approximate center of the landfill, there is a blue, metal building which served both as an office and an equipment repair facility.

Along the east side of the landfill near the Unnamed Tributary, six (6) leachate seeps have been identified. These outbreaks flow out of the earthen slope or from the bank of the Tributary. Another seep breaks out onto a low-lying area in the southwest quadrant of the landfill.

### 1.2 SITE HISTORY

The Smith's Farm property is very hilly and not suitable for farming or forestry; the hills have steep-sloped sides with little flat area between. The proximity of industries in and around Louisville, and the need of those industries to dispose of their

wastes cost-effectively, resulted in the unpermitted and permitted disposal of industrial and commercial wastes in two (2) major areas and several smaller areas at the Site. Some of the Site's ravines served as disposal "ditches" for construction debris, old household appliances, auto bodies, unsalvageable metallic industrial equipment, used tires, used drums, drummed wastes, and uncontainerized liquid and solid wastes. The 37.5-acre landfill area, which was composed of a hilly ridge with a ravine on each side, was permitted by the Commonwealth of Kentucky to accept inert industrial wastes from November 1973 to May 1989, although the landfill area had industrial waste placed in it since the 1950's. The permit was not in effect continuously and several violations occurred. The landfill was operated by the property owner, Mr. Leonard O. Smith, Sr., until his death in 1969, and by his son, Harlan Smith, until his death in 1978. The current landfill and property owner is Mrs. Mary Ruth Smith, whose nephew, Buddy Mobley, has operated the landfill.

In 1984, following several inspections by USEPA and Commonwealth regulatory personnel, an immediate removal of surface drums, which contained hazardous waste, from the unpermitted disposal area (the area addressed by Operable Unit One) was conducted by USEPA. The Smith's

Farm Site was added to the National Priorities List in June 1986.

During the 1980's, the landfill owner contracted for the installation of a small leachate collection and recirculation system at the landfill at the insistence of the Commonwealth. Leachate lines of perforated plastic pipe were installed in ditches at the overburden/bedrock interface on the southeastern and southern sides of the landfill. The collected leachate went to a surge/collection tank and then to a large pump from which it was pumped up to the central part of the landfill where it was sprayed onto the surface of the landfill from several vertical plastic pipes. The system was used only intermittently and then, reportedly, was shutdown before the 1988-89 Operable Unit One Remedial Investigation because of air emissions problems and complaints from residents of the mobile home park to the south of the landfill.

Reportedly, also during the 1980's, the landfill operator, in an attempt to dispose of large volumes of scrap wood, set piles of wood debris on fire in the northeast and northwest quadrants of the landfill. Later the operator buried the smoldering wood debris in an attempt to smother the fires. The attempt to smother the fires was not completely successful and over the next few years the operator made subsequent attempts to smother the subsurface combustion by bulldozing the areas. During the 1990 Operable Unit Two Remedial Investigation, infrared aerial photography indicated that thermal anomalies (surface soil temperatures of 75-80 degrees Fahrenheit on a cool morning) still existed; one in the northeast and one in the northwest quadrant of the landfill.

In 1988, field activities for the Operable Unit One RI/FS occurred. The RI for Operable Unit One determined that leachate seeping from the permitted landfill contains several volatile organic compounds (i.e., chlorinated aliphatics, ketones, and monocyclic aromatics) and heavy metals. The Unnamed Tributary stream sediments are contaminated by extractable organic compounds (i.e., polycyclic aromatic hydrocarbons) and heavy metals which are attributable to releases from the permitted landfill, as well as the unpermitted drum disposal area. Soil samples collected from a location next to the landfill were also contaminated with extractable organic compounds.

The permit for the landfill expired on May 10, 1989. The Commonwealth of Kentucky determined that the permit should not be renewed because (1) a completed permit application had not been received (Kentucky Revised Statutes Section 224.855); (2) hazardous substances had been released from the permitted landfill and therefore remedial action to control the release(s) was required (Kentucky Revised Statutes 224.877); and (3) information required in order for the Commonwealth to re-evaluate the permit's renewal would be available only through a Site study comparable to a Superfund Remedial Investigation (401 Kentucky Administrative Regulations 47:020 Section 5).

The nature and extent of the releases from within the general area of the formerly permitted landfill and the threat to human health and the environment posed by these releases has been determined. The potential for contamination of the deeper ground water by leachate from the Operable Unit Two formerly permitted landfill and the Operable Unit One unpermitted drum disposal area has been investigated and has been demonstrated to be insignificant due to the extremely low permeability of the underlying shale geology. Therefore, the deep limestone aquifer is not being addressed by the selected remedy in this Record of Decision.

## **2.0 ENFORCEMENT HISTORY**

Although Operable Unit Two is being treated as a separate phase of the investigation and remediation of the Smith's Farm Site, the enforcement activities for both Operable Units are intertwined.

During the summer of 1984 general notice letters and information request letters were issued and the search for potentially responsible parties (PRPs) was initiated. During the spring of 1987,

RI/FS special notice letters were issued to the PRPs. A 1984 removal, which was conducted at the area addressed by Operable Unit One by USEPA Region IV Emergency Response authorities, is the subject of an ongoing CERCLA Section 107 cost recovery suit. In March 1990, the Department of Justice (DOJ) on behalf of USEPA filed civil action No. C-90-0232-L(M) against the owner and four (4) other PRPs who sent waste to the Site. On February 7, 1992 four (4) of the Defendants filed a CERCLA-based suit against fifty-three (53) other PRPs in U.S. District Court, Western District of Kentucky at Louisville, attempting to recover past, present, and future remediation costs for both Operable Units of the Site. The remediation schedule for the Operable Unit One area is in the Remedial Action (RA) phase under a March 14, 1990 Unilateral Administrative Order (UAO) addressed to thirty-six (36) of fifty-seven (57) PRPs and according to a September 30, 1991 Amendment to the September 29, 1989 Operable Unit One Record of Decision (ROD). The UAO was amended three (3) times to incorporate schedule changes due to the accomplishment of the ROD Amendment. An Administrative Order by Consent (AOC) for a Remedial Investigation/Feasibility Study (RI/FS) of the Operable Unit Two formerly permitted landfill, and proximal Site areas, was signed by only one (1) of fifty-seven (57) PRPs on November 9, 1989. The RI/FS was completed in January 1992. Upon completion of the Operable Unit Two ROD, USEPA will give the PRPs an opportunity to perform the remedy. If the PRPs refuse to perform the remedy as set forth in the ROD, USEPA has the option to order compliance through a Unilateral Administrative Order (UAO) or to undertake to conduct the Remedial Design and Remedial Action utilizing Superfund money and later pursuing the PRPs for cost recovery under CERCLA Section 107.

Table 2.0 outlines the Smith's Farm Site's remedial history.

### **3.0 HIGHLIGHTS OF COMMUNITY RELATIONS**

As with the enforcement activities, the community relations activities for the two Operable Units or phases are interrelated.

The September 29, 1989, Operable Unit One ROD was based upon the RI completed in January 1989. A public information meeting was held on March 12, 1988 to address existing community concerns, including the sampling and analysis of water from private wells, and to provide the community with information about the studies that were conducted or that were planned for the Site. After the release of the Feasibility Study to the public, another public meeting to describe current conditions at the Site and the preferred alternative for cleanup was held on April 11, 1989. The purpose of the meeting was to discuss the alternatives considered for Site cleanup and to solicit comments on the proposed cleanup plan. The Operable Unit One ROD was signed on September 29, 1989.

On April 28, 1991, a fact sheet for the Smith's Farm Site was sent out with the Proposed Plan fact sheets for the Tri-City Site given that many of the interested parties were the same. The Smith's Farm fact sheet contained a description of the Proposed Fundamental Change to the Operable Unit One original remedy as well as a description of the then current Operable Unit Two activities. On May 9, 1991 two public meetings were conducted back-to-back at the same location. Tri-City Industrial Disposal Site Proposed Plan public meeting was followed by the Smith's Farm Site meeting at which the current status of both Operable Units was presented and questions from the public were entertained. On July 15, 1991, USEPA published a notice in a local newspaper describing the purpose of a public meeting to occur on July 18, 1991, and opening the public comment period for the proposed fundamental change to the Operable Unit One ROD. The public meeting occurred on July 18, 1991 with television and newspaper coverage. The public comment period extended from July 15, 1991 through August 15, 1991. Comments were incorporated into the Responsiveness Summary for the Operable Unit One ROD Amendment which was signed on September 30, 1991.

On May 1, 1992, a Proposed Plan Fact Sheet for Operable Unit Two was mailed to more than 130

interested parties. On May 15, 1992, a meeting notice was printed in the local newspaper; the public comment period was started and the public meeting was set for May 21, 1992. The public comment period was from May 6, 1992 to June 8, 1992. The public meeting occurred on May 21, 1992. Media coverage was provided by local newspapers and television stations.

#### **4.0 SCOPE AND ROLE OF THE OPERABLE UNIT WITHIN THE SITE STRATEGY**

Under certain conditions the remediation of the problem(s) posed by a Superfund site can be more effectively dealt with in stages, or operable units. The Smith's Farm Site is approximately 460 acres which includes an approximate eighty (80) acre area of unpermitted drum disposal, a thirty-seven and one-half (37.5) acre formerly permitted solid waste disposal landfill, and additional areas of suspected drum disposal. In the summer of 1987, USEPA Region IV and the Commonwealth of Kentucky defined an area (the eighty [80] acre unpermitted drum disposal area) that needed immediate attention in the form of an RI/FS. This area appeared to be the most potent threat on the Site based upon the large number of drums in the area and the suspected waste types present. USEPA determined that other areas on the Site would be evaluated at a later date depending upon the results of the initial RI/FS.

During the spring of 1988 while the Remedial Investigation (RI) field sampling program was being determined, USEPA decided to defer the investigation of the deep aquifers beneath the Site. Among the reasons for this decision were the complexities of and the time associated with implementation of a full hydrogeological study and the reasonable premise that contaminants were being transported primarily by surface water runoff and through shallow hydrogeological pathways. Meanwhile, sampling of private drinking water supplies in the area of the Site was performed quarterly from the spring of 1988 until April 1990 and no degradation of ground water quality was detected.

In the spring of 1989, the Commonwealth of Kentucky informed USEPA Region IV of its decision not to renew the Smith's Landfill solid waste disposal permit and requested that USEPA proceed with an RI/FS of the Landfill area.

Operable Unit One, authorized by the September 29, 1989, Record of Decision, which was amended by the September 29, 1991, Record of Decision Amendment, addressed the contaminated soils, sediments, surficial aquifer, and drums of the eighty (80) acre unpermitted drum disposal area. Operable Unit Two addresses the thirty-seven and one-half (37.5) acre formerly permitted landfill, the aquifers underlying the landfill, and outlying, small areas of contamination. The contaminated media to be addressed by the Operable Unit Two ROD remedy are the landfill wastes, the leachate, the leachate sediments, and surface soils.

#### **5.0 SUMMARY OF SITE CHARACTERISTICS**

##### **5.1 ENVIRONMENTAL SETTING**

###### **5.1.1 Climate.**

The area has four (4) distinct seasons with average daily maximum temperatures for Bullitt and Spencer Counties ranging from 41.7 degrees Fahrenheit in January to 88.7 degrees in July. Average daily minimum temperatures for the same months range from 21.1 degrees to 63.1 degrees, respectively.

The annual average precipitation is 55.5 inches and is fairly evenly distributed on a monthly basis. Snowfall generally occurs during the months of November to March and is greatest in January (10.6 inches average). Total average annual snowfall is 18.5 inches.

#### 5.1.2 Flora and Fauna.

The dominant vegetation type in the area is mixed deciduous forest. This plant community is dominated by a large diversity of broad-leaved trees in both the higher and lower tree levels.

The terrestrial portion of the Site varies in relative elevation by between two hundred (200) and two hundred and fifty (250) feet. The sharp slopes and narrow ridges allow for a variety of habitats and species. This Site is heavily vegetated with mixed pine and hardwood forest growth, which appear to be twenty-five (25) to forty (40) years old, except for the landfill which is covered with dense grasses. The nearby residences are also wellgrassed.

Aquatic systems in the Unnamed Tributary are minimal. The bedrock streambed is covered with sand, gravel, and cobbles. Typically, the upper reaches of the streams have no flowing water. High water flows occur during storm events and are of short duration.

Terrestrial fauna consist of the usual small mammals, reptiles, birds, and amphibians associated with second and third growth forests in the area. A listing of flora and fauna and Endangered and Threatened Species can be found in Section 4.6.7 of the Operable Unit Two Remedial Investigation.

#### 5.1.3 Geology.

Underlying the Site is the Mississippian-age Borden formation, which in descending order includes the Holtzclaw Siltstone Member, the Nancy Member (silty shale), the Kenwood Siltstone Member, and the New Providence Shale Member. The depth the bedrock onsite is commonly four (4) to six (6) feet, and rock outcrops have been observed. Underlying the Borden Formation is the Devonian-age New Albany shale, which overlies the Silurian-age Louisville Limestone. The Silurian and Devonian-age rocks crop out approximately one (1) mile east of the Site.

The rocks underlying the Site are nearly horizontal; the regional dip of the top of the New Albany shale is to the west at about 110 feet per mile. No major faults have been mapped by the U.S. Geological Survey in this part of Kentucky. Some joints and possibly small-scale faults are expected to be present in the rocks underlying the Site.

#### 5.1.4 Soils.

Soils of the area are loamy on the slopes and ridges, and gravelly loam in the small tributary floodplains of the Site. Soils are either the product of weathering of the underlying bedrock, or are derived from material washed downslope from nearby source areas.

#### 5.1.5 Hydrogeology.

The evaluation of the Site hydrogeology involved several investigative methods, including (1) rock coring and packer testing, (2) downhole geophysical logging, (3) monitoring well installation, and (4) water level measurements. These investigations produced enough data to create a conceptual hydrogeologic model for the Site.

Geophysical logging responses and drilling observations suggest that the thick sequence of shale, comprised largely of the New Providence Shale and the New Albany Shale, inhibits the vertical percolation of surface infiltration and provides a natural barrier to the more prolific limestone aquifer below. Ground water may occur within isolated fractures, formational contacts and bedding planes in the shales resulting from vertical infiltration of recharge water, but these zones do not appear to be very interconnected. This water does not appear to be under any artesian pressure.

No monitoring wells were installed into the limestone aquifer for the Operable Unit Two Remedial Investigation. Information on the water-bearing capacity of this unit has been gained largely from the coring and test hole drilling in which approximately ten (10) feet of the limestone section was penetrated. Cuttings from the air rotary drilling of the test holes generally were dry and powdery through the shale sequences, until the limestone was penetrated and water was blown out of the hole. Vugs (pits) and cavities were observed in the recovered limestone core which provide the ground water storage capacity in the limestone. This data suggests that the limestone serves as the principal uppermost aquifer in the area. However, within the Bluelick Creek drainage basin more domestic water supply wells have been completed into the shales or siltstones than into the underlying limestone. Therefore, while the shale or siltstone may be a regional confining unit containing very poor quality water, a part of the lower and more permeable zone in the shale may be considered an aquifer based upon the local ground water withdrawal pattern.

Another hydrogeologic system in the area is the alluvial valley and surficial soil/weathered bedrock setting. Several shallow monitoring wells were installed within the surficial soil and weathered bedrock (shale) during the Operable Unit One activities, to a depth of approximately ten (10) feet. These shallow wells intercept the shallow water that infiltrates through the surficial soils and flows along the soil/bedrock interface. This flow discharges into the alluvial valley deposits, as evidenced by numerous flowing leachate outbreaks observed along the Unnamed Tributary streambank. Flow within the alluvial water table aquifer follows the direction of surface water flow in the valley stream. In other words, flow is controlled by topography.

It seems likely, based upon the observed hydrogeologic properties of the shales, that the majority of recharge water filtering through the surficial soils, and forming the shallow or perched water zone at the weathered rock/soil interface, flows laterally and discharges into the major valley alluvial aquifers. Some recharge water infiltrates through vertical/near vertical fractures in the shale and accumulates in areas where the fracture zones tighten. The volume of water present in the shale and the rate of recharge is considerably less than the confined limestone aquifer below. The potential for vertical migration of significant quantities of leachate present within the landfill through the thick shale sequences to the limestone aquifer is not significant. See Figure 5.1, entitled "Conceptual Hydrogeologic Model".

#### 5.1.6 Surface Water and Topography.

The Site topography is characterized by conical-shaped knobs which are connected by long, narrow ridges and steep hillsides and ridgetops. The ridges and knobs are dissected by intermittent stream channels and small flowing streams. Ground surface elevations vary from about 800 feet AMSL (above mean sea level) on ridgetops and knobs to about 500 feet AMSL along the valleys.

Operable Unit One is located along a narrow ridge in the northcentral portion of the Site. Intermittent valley streams flank both sides of the ridge and drain into a larger major valley stream channel ("Unnamed Tributary") along the eastern side of the property. The Unnamed Tributary drains into Bluelick Creek which empties into Floyds Fork immediately south of the Site, then into the Salt River further to the southeast. The landfill is located in the south-central portion of the Site. A mobile home park exists off of Pryor Valley Road south of the Site.

Land surface elevations within the formerly permitted landfill vary from approximately 645 feet AMSL in the northwest corner of the landfill to 618 feet AMSL near the large maintenance building on-Site. The ground surface elevation drops abruptly to approximately 545 feet AMSL east of the large maintenance building to the Unnamed Tributary. A small amount of surface runoff follows valley slopes to the southwest into the intermittent tributaries which flow into Bluelick Creek. Figure 5.2 shows the Site drainage patterns, and indicates that the Site is

confined to a narrow watershed which drains to the Unnamed Tributary and then into Bluelick Creek.

## 5.2 GEOPHYSICAL INVESTIGATION RESULTS

### 5.2.1 Areal Extent of the Landfill.

To estimate the horizontal limits of the landfill material, data from several geophysical surveys were interpreted together. In many locations, there was a distinct contrast between the highly anomalous data collected over landfill material and the background soils and rock surrounding the landfill. Figure 5.3 shows the limits of the main landfill based upon (1) total magnetic field intensity, (2) magnetic gradient, (3) apparent conductivity, and (4) electromagnetic in-phase disturbance. Each line of electromagnetic data was plotted versus distance. These plots were primarily used in the interpretation of the landfill boundary. Contour plots of these data were used primarily for identifying anomalies within the landfill and not for determining the boundary because of the smoothing that occurs when generating contour plots.

### 5.2.2 Vertical Extent of the Landfill.

The depth to the bottom of the landfill material was investigated using (1) seismic refraction and (2) electrical resistivity techniques. The depth of penetration of electrical resistivity soundings was somewhat limited by the highly conductive and variable subsurface material. The soundings were used mainly to provide qualitative information about the vertical distribution of landfill material. See Figure 5.4 and Figure 5.5 which demonstrate the depth of the landfill material and the estimated pre-landfill topographic surface, respectively. The average depth of the western portion of the landfill is approximately forty (40) feet. The eastern portion's average depth is about thirty (30) feet.

### 5.2.3 Landfill Characterization.

Areas of concentrated metallic debris and high apparent conductivity were located within the landfill. These interpretations are based on geophysical surveys: (1) electromagnetic conductivity (EM-31 and EM-34 measurements), (2) electrical resistivity, and (3) magnetometry. Contour plots of each survey technique were made using commercially available software. These contour plots, along with X-Y plots of the data, were used to interpret areas containing larger amounts of buried metallic material. In the Remedial Investigation, one contour plot (with a contour interval that provided a reasonably uncluttered figure) of each of the above techniques was presented. For brevity's sake only one figure, Figure 5.6, is presented here. Figure 5.6 shows contoured apparent conductivity data and shaded areas representing some of the more intense anomalies. These anomalies are interpreted to be due to buried iron or nickel in greater quantity than other parts of the Site.

### 5.2.4 Mapping of the Subsurface Conductive Plume.

Based upon a preliminary analysis of geophysical data, a concentrated search for a conductive plume, possibly related to ground water contamination was conducted southeast of the landfill area. The search was made using the EM31 conductivity meter. The interpreted plume may emanate from the landfill toward the tributary. It is reasonable to conclude that this plume is discharging to the Unnamed Tributary. Leachate outbreaks are present at the soil/shale interface along points adjacent to the interpreted plume on the west side of the stream bank of the Unnamed Tributary.

### 5.2.5 Reconnaissance of the Unnamed Tributary.

The purpose of the reconnaissance of the Unnamed Tributary was to investigate areas of buried metal identified during the Operable Unit One Remedial Investigation/Feasibility Study. This reconnaissance was accomplished using an EM-31 device.

Anomalous zones were differentiated based on the occurrence of metallic objects observed on the surface. The metallic objects observed on the surface included drums, vehicles, and other material. The anomalies in these zones are likely caused by the surface metallic objects, but buried drums could exist in these areas, but were masked by the surface debris.

#### 5.2.6 Infrared Thermal Imagery.

During the course of the geophysical surveys, it became apparent that a small amount of vapor was venting from cracks in the landfill cover in an area northeast of the large maintenance building. The former landfill operator indicated that a smoldering subterranean fire was causing the venting. This condition had existed for several years and was the result of a wood fire that the landfill operator had repeatedly attempted to smother with soil cover. An aerial infrared thermal survey was conducted. Two thermal anomalies were identified; one in the northeast of the landfill where the vapor vent was detected and a smaller, less intense one in the northwest part of the landfill (Figure 5.7).

#### 5.2.7 Radiological Survey.

Utilizing a surveyed grid, a radiation scan was performed over the landfill on June 26, 1990. An Eberline ESP-2 Smart Portable instrument was equipped with detectors to measure gamma, alpha, and beta radiation. No significant variances were observed.

#### 5.2.8 Summary of Results.

The areal extent of the landfill was determined from a combination of geophysical methods. The interpreted areal extent of the landfill is approximately twenty-nine (29) acres, although the area effected by the landfill is about thirty-seven and one-half (37.5) acres.

The seismic refraction work provided an estimate of landfill depth and was used to construct an isopach (i.e., an isogram that connects points of equal thickness of a geological stratum formation or group of formations) map of the landfill material. The landfill was interpreted to consist of two filled ravines on either side of a north-south trending ridge. The interpreted maximum depth of the landfill is approximately sixty (60) to seventy (70) feet in the western ravine, and fifty (50) to sixty (60) feet in the northeastern ravine.

Within the landfill, several areas interpreted to have substantial quantities of buried metallic material were identified. The location of these areas supports the concept of two ravines of fill on either side of the landfill access road interpreted from the seismic refraction data.

A potential conductive plume was mapped on the southeast side of the landfill. This plume seemed to lead from the landfill toward the Unnamed Tributary. Surface metal interfered with the collection of electromagnetic (EM) data in much of the plume search area. Zones of surface metal and buried metal objects were outlined near the Unnamed Tributary. The landfill received a variety of wastes during its operation over the years. However, information obtained from Site files and from intrusive investigations indicate that the volumetric majority of the landfill waste is construction debris, inert industrial waste, and municipal solid waste. Specific chemical wastes and generic wastes reported in the USEPA and Commonwealth of Kentucky Site files as having been disposed of in the landfill are listed in Table 5.0. Many of these wastes are hazardous substances, pollutants, or contaminants. Industrial/commercial wastes disposed between the mid-1950's and the mid-1980's included: acrylic and enamel paint wastes

and sludges, various resin and epoxy wastes, waste grease and oil from machining processes, waste solvents, flyash, metallic sludges, sewage treatment grit, wood and paper packaging waste, soil contaminated with petroleum products, commercial solid waste from business offices, and construction debris (wood, iron, ceramics, etc.) from demolished buildings. These wastes were deposited as both drummed and bulked liquids and solids. Poor documentation of disposed materials prevents an accurate assessment of the actual locations where waste disposal occurred and the volumetric quantification of the different categories which were disposed. Additional information regarding the Site's disposal history can be found in the Administrative Record and in the Commonwealth's files on the formerly permitted landfill.

### 5.3 CONTAMINATION IN THE STUDY AREA

Tolerance limits derived from background concentrations were developed for inorganic constituents in the surface water, soil, and sediment in order to allow for statistically significant variations in the background concentrations of the contaminants of concern. Thus, a numerical limit was set for the acceptance of higher background concentrations of soil contaminants. Any surface water, soil, or sediment sample concentration above the tolerance limit for that particular chemical was considered significant and an indication of contamination for the purpose of calculation of risks. Tolerance limits for soil were determined by adding the mean concentration of the background samples for a particular constituent in a particular medium to two times the standard deviation from the mean ( $TL = \text{Mean} + (2 \times \text{Standard Deviation})$ ). This approach attempts to increase the confidence that concentrations exceeding the tolerance limit are truly significant. Due to the limited sample size for surface water, the maximum observed concentrations from some sample locations were used as the tolerance limits. Ground water data was evaluated by comparing detected constituent concentrations to USEPA Interim Primary Drinking Water Standards.

Analytical data from samples from each media were compared to the appropriate tolerance limits. Soil, surface water sediment, and leachate sediment data were compared with the soil tolerance limits. Surface water and leachate water data were compared to the surface water tolerance limits. Ground water data were compared to drinking water standards. Samples with constituents exceeding the tolerance limits were identified as having significant constituent concentrations.

No background concentrations were derived for volatile organic, semi-volatile organic, and pesticide/PCB constituents as these are not naturally occurring. Any concentration detected above the Contract Required Detection Limit (CRDL) was considered significant enough to identify an area as having significant constituent concentrations. These areas were separated on a quantitative basis.

TABLE 5.0

**SMITH'S FARM - OPERABLE UNIT TWO  
PARTIAL WASTE INVENTORY**

Generic Wastes	Specific Chemicals
Asbestos	Abietic Acid
Adhesives, Sealers	Aluminum Phosphate
Alkyd Resins	Biphenyl (Diphenyl) ("Downtherm A")
Adipyl Chloride/Reacted bottoms (organic, acids, surfactants, phosphates)	DDT (1,1 bis (4chlorophenyl) 2-2-2-trichloroethene)
Boderite Sludge (zinc phosphate,Cr,Pb)	Diphenyl Oxide ("Downtherm A")
Boiler Ash	Dichloroethane
Binders (epoxy, acrylic, polyester, vinyl,urea,butyrate, nitrocellulose)	Dimethylcyclohexylamine
Bleaching Clay (spent)	Ethyl Benzene
Clay/Waste Sludge	Ethanolamine
Coal/Dust Sludge	Iron Phosphate
Coal DustEmulsion	Mineral Spirits
Coating Grease, Cutting Oil	Nitrocellulose
Diesel Fuel/Soil	Polystyrene
Epoxy/Hydrocarbon Solvents	Phenylmercuric Acetate
Foundry Mill Dust	Phosphoric Acid
Flyash	Sodium Hydrosulfite
Grease Wastes	Toluene
Ion Exchange Resin	TEA (Triethanolamine)
Km Polymer,KAC Pellets,Kx Polymer	Toluene Diisocyanate
Latex Paint wastes	Vinyl Toluene
Mineral Spirits	Xylene
Nickel Sludge	Zinc Phosphate
Oil Separator Sludge	
Plexiglass, Acrylic Plastic	
Porcelain Enamel Frit	
Paint Sludge	
Plastisol Primer Waste	
Pigments	
Polyester Resin	
Rubber Waste Hycar 1312	
Resin 3003	
Silica Gel	
Sewage Treatment Grit	
Sulphoric Acid Sludge	
Zinc Sludge	

Source: USEPA and Commonwealth  
of Kentucky Permitted  
Landfill Files

#### 5.3.1 Exploratory Trenching Results.

In October 1990, samples were obtained from two soil test borings and several drums were unearthed during exploratory trenching to help characterize the landfill wastes.

Sample STB-2 was a dark sludge obtained in the vicinity of a buried drum area in the northeast portion of the landfill. Sample STB-2 contains relatively high concentrations of several inorganic constituents (Table 5.2, Attachment 5.0) when compared to STB-4, drum or leachate samples. Analytical results from STB-4 and drum samples, designated "TP", generally exhibited lower inorganic concentrations compared to the soil test boring sample STB-2. Observations made at the time of sampling indicate that each drum may have contained a specific type of waste. Therefore, high concentrations of a variety of constituents were not expected.

PCB-1254 was detected in an oily sample obtained from location STB4 at a concentration of 1700 ug/L (ppb).

Three groups of volatiles were the predominate organic constituents detected in waste samples. These groups consisted of (1) benzene, toluene, ethylbenzene, and xylene (BTEX), (2) trichloroethene, and (3) the ketones, 2butanone and 4-methyle-2-pentanone. Analytical results for the waste samples are summarized in Table 5.3, Attachment 5.0. The waste sample at STB-2 contained total volatile organics greater than 15,000 mg/kg (ppm). The waste sample at STB-4 contained total volatile organics greater than 12,000 mg/L (ppm). Most of the aforementioned constituents were detected in these samples.

Samples collected from drum locations ("TP") all contained less than 100 mg/kg (ppm) of total volatile organics. The constituents detected were limited to those previously discussed and varied with the drum waste sampled. Very few semi-volatiles were detected in the waste samples. Sample TP-D-1 contained 120 mg/kg (ppm) of bis (2-ethylhexyl) phthalate, suggesting this area may be a source for this constituent. Another drum sample, TP-F-1, contained 13-15 mg/kg (ppm) of total semi-volatile constituents.

The data, in conjunction with the absence of substantial concentrations of inorganic constituents, suggest that the drummed waste samples contain organic wastes. The soil test boring samples from the landfill contained an expected variety of organic and inorganic wastes.

#### 5.3.2 Leachate and Leachate Sediment

Leachate and leachate sediment samples were collected in September 1990 and March 1991 from seven (7) of the leachate seep locations shown in Figure 5.8.

Several inorganic constituents were detected in leachate water and sediment samples at concentrations above the surface water and soil tolerance limits, respectively. This comparison was made to better characterize the leachate as a contributor to migration of constituents at the Site. Analytical results for the leachate water (LW) and sediment (LS) are shown on Tables 5.5 and 5.6, Attachment 5.0, respectively.

- . A similar group of constituents was detected in excess of the soil tolerance limit from samples LS-01, LS-02, and LS-03. At least two of these samples each contained arsenic, barium, cadmium, calcium, lead, manganese and zinc in concentrations greater than the tolerance limit. This suggests a similar source such as run-off from the northeast area of Operable Unit Two which is known to contain a significant amount of buried wastes.
- . Results from LW-01, W-02 and LW-03, taken at locations along the western bank of the Unnamed Tributary where leachate from the landfill was breaking through the overburden,

indicate constituents such as aluminum, barium, calcium, iron, magnesium, manganese, sodium and zinc present at concentrations greater than the surface water tolerance limit, but with arsenic, cadmium and lead below the tolerance limits. This suggests that these metals are adsorbing to the soil at these outbreak locations.

- . Several constituents exceed the tolerance limits at locations LS-05 and LS-06 and LW-05 and LW-06. These locations are near the leachate collection tank and pumphouse for the old landfill leachate collection system which was installed by Mrs. Smith.
- . Leachate water sample LW-08, collected from within the landfill in an area of partially buried drums, contained the highest concentrations of several metals found in the leachate water samples.

No pesticide or PCB constituents were detected in the leachate water and the leachate seep sediment samples collected in the vicinity of the landfill.

Several volatile and semi-volatile organic constituents were detected in leachate water and sediment samples. Analytical results for the leachate water and sediment are summarized in Tables 5.5 and 5.6, Attachment 5.0.

- . Low concentrations (<100 ug/L [ppb]) of trichloroethylene and other related constituents were detected in LW-01 and LW-02, suggesting a similar source for these leachate outfalls. Similar constituents were detected in LS-02, indicating a possible impact of the leachate water on the outbreak sediments.

Volatiles were detected in samples from LW-06 and LS-06 in excess of 10,000 ug/L (ppb) and 5 mg/kg (ppm), respectively. These constituents are believed to originate from the landfill leachate collection system.

Samples from LS-08 and LW-08 contained high concentrations of volatile organic constituents. It is probable that liquid waste containing volatile organic chemicals is leaking from partially buried drums in this area and is causing the high concentrations. Several semi-volatile constituents were detected in leachate from the landfill. The majority of these are polynuclear aromatic hydrocarbons (PAHs).

- . Very high concentrations of semi-volatile constituents were detected at locations LW-08 and LS-08. This location is within an area of buried drums in the southwest quadrant of the main landfill.

A variety of PAHs were detected at locations LS-05 and LS-06. Several of the same constituents were detected at location SD-23, sampled during the Operable Unit One Remedial Investigation in the vicinity of LS-05 and LS-06. In conjunction with inorganic data, and considering that these sampling locations were near the leachate collection tank, these data appear to represent a composite of the leachate that drains from the landfill.

- . Several PAHs were detected in the LS-03 sample while only a few were detected at LS-01 and LS-02. This suggests that although these three (3) locations may be affected by a similar inorganic source, a separate, smaller source of semi-volatile organics in the northeast area of the landfill may be affecting the vicinity of LS03.
- . Overall, semi-volatile contamination is more evident in the leachate sediment samples. This is expected as most of these constituents are immiscible in water and will accumulate in the sediment because of their greater density.

### 5.3.3 Surface Water and Stream Sediment Contamination.

Surface water and stream sediment samples from the Unnamed Tributary were obtained during the two sampling events. Sampling locations are shown on Figure 5.9. Samples from SW-01 and SW-02 each contained aluminum, iron, and manganese above the tolerance limit. Sediment samples from these same locations (SD-01 and SD-02) each contained barium, copper, and manganese above the tolerance limit. The data suggest that these two locations are similarly affected by the intermittent stream flowing from the southwest edge of the landfill.

Antimony, beryllium, cadmium, cobalt, nickel, vanadium, and zinc were detected above the tolerance limit at SD-03. Except for zinc, these constituents were not detected in surface water samples from the same location. This suggests that location SW/SD-03 is affected by a different source than SW/SD-01 and SW/SD-02, and these metals may no longer be migrating from the landfill in the SW/SD-03 area.

Surface water samples SW-04 and SW-05 each contained a similar group of constituents above the tolerance limit. This group consisted of calcium, iron, magnesium, potassium, and sodium. Both samples were obtained along the Unnamed Tributary and were anticipated to produce similar analytical results. Sample SW-04 also contained lead, manganese, and selenium slightly above their respective tolerance limits.

Sediment samples SD-04 and SD-05, located along the Unnamed Tributary south of the landfill, each contained concentrations of barium, calcium, copper, magnesium, manganese, and nickel above their respective tolerance limits. In addition, sample SD-05 contained arsenic, cadmium, cobalt, lead, and zinc above the tolerance limits. This suggests that the two locations are affected by the same source or sources and that the heavier metals are adsorbing to the soil prior to reaching location SD-04 which is located approximately 1,200 feet downstream of SD-05.

Pesticides and polychlorinated biphenyls (PCBs) were not detected in any surface water or surface water sediment samples obtained during the Operable Unit Two Remedial Investigation.

Analyses for organic constituents in surface water and sediment samples indicated several low (< 30 ppb in water, < 1 ppm in sediment) concentrations of constituents often detected as laboratory contaminants.

The volatiles, 2-butanone, 4-methyl-2-pentanone, and acetone were detected in sample SW-04. These ketones were also detected in nearby leachate water sample LW-06.

Semi-volatiles were detected at SW-04 and SW-05 in total concentrations of 116 ug/L (ppb) and 32 ug/L (ppb), respectively. Location SW-05 is likely affected by leachate outbreaks along the Unnamed Tributary. Constituent concentrations at SW-04 are probably the result of migration from leachate outbreaks LW-05 and LW-06.

Several semi-volatiles were detected in sample SD-05, approximately one hundred (100) feet downstream of SW-04. The total semi-volatile concentration of 26.9 mg/kg (ppm) is considered the result of migration from the existing leachate collection system tank area for the landfill. These immiscible constituents may be adsorbing to the Unnamed Tributary sediments. This is supported by the absence of several of these constituents in nearby surface water sample SW-04 and a reduced variety and concentration of semi-volatiles detected downstream at SD-04.

During the Operable Unit One Remedial Investigation, surface water samples and sediment samples were collected along Bluelick Creek and the Unnamed Tributary. Surface water and sediment immediately south of the landfill contain similar inorganic constituents above tolerance limits established for the Operable Units One and Two Remedial Investigations. Concentrations in both

investigations for the sediments are similar; however, concentrations for surface waters are higher for Operable Unit Two than for Operable Unit One. PAHs are higher for Operable Unit Two in both surface waters and sediments compared to Operable Unit One.

#### 5.3.4 Surface and Subsurface Soil Contamination.

Surface and subsurface soils were sampled as part of the Operable Unit Two Remedial Investigation at the locations identified on Figure 5.10. Samples were taken along the approximate perimeter of the landfill to better define the landfill's extent. Samples were also taken at some distance from the landfill to determine the constituents of background surface and subsurface soils.

Samples obtained from locations SS-03A, SS-05A, SS-06A, and SS-07A each contained cobalt and manganese concentrations above the tolerance limit and SS-05A and SS-06A contained lead above the tolerance limit.

Samples SS-10A and SS-20A, obtained from the southeast edge of the landfill, contained a similar variety of metal concentrations above the tolerance limit, as shown in Figure 5.10 and Table 5.7, Attachment 5.0. It is probable that these locations are affected by run-off from the southeastern area of the landfill. Another potential source is an old leachate collection system header that extends along the eastern side of the landfill.

Concentrations in samples from locations SS-13A and B, SS-14A and B, SS-15A, SS-16A, SS-17A, SS-18A, and SS-19A exceeded the tolerance limit for at least one of the following: cobalt, copper, manganese, vanadium, and zinc. These locations all along the western side of the landfill, appear to have been affected by a similar source. Geophysical data indicated areas of high conductivity in the proximity of SS-17A, SS-18A, and SS-19A. The material deposited in these areas is a likely source of the measurable contaminants. The source material may have consisted of foundry wastes, pigments, or sludges which were disposed of at the Site, according to documentation.

The sample from location SS-19A, located closest to an area of high conductivity and above normal background temperature also contained concentrations of mercury and cyanide at 0.59 and 2.8 mg/kg (ppm), respectively. These constituents were not found in any other soil samples collected as part of the Operable Unit Two Remedial Investigation. Several pesticides were detected at sampling location SS-20A (Figure 5.10). These detections indicate a possible area of pesticide concentrations localized around SS-20A. This conclusion is supported by the absence of measurable pesticides in all other sampling media and sampling locations in the Operable Unit Two area.

Several semi-volatile constituents were detected at five (5) of the surface soil sampling locations in the vicinity of the area addressed by Operable Unit Two (Table 5.7, Attachment 5.0). Analytical results indicated very low concentrations of volatile organic compounds (VOCs) identified as laboratory contaminants. Thus, only semi-volatile data was considered in assessing surface soil organic contamination.

Several polynuclear aromatic hydrocarbons (PAHs) were detected in soil samples from SS-7A, SS-8A, SS-10A, and SS-18A. With the exception of SS-18A, the total semi-volatile constituent concentration was less than 3 mg/kg (ppm) at each of these locations. The total for these four (4) soil samples exceeded 20 mg/kg (ppm). The data suggests that SS-7A, SS-8A, and SS-10A are probably affected by leachate from the outbreaks along the eastern side of the landfill. Additionally, SS-18A is probably affected by a localized source, e.g., buried material in the northwest portion of the landfill. This contention is supported by the absence of significant semi-volatile concentrations in nearby samples.

Analytical results for subsurface soils (Table 5.8, Attachment 5.0) indicate very small concentrations (<0.1 mg/kg [ppm]) of VOCs resulting from laboratory contamination. Thus, no significant contaminant concentrations are considered to exist in the subsurface at the four (4) subsurface soil sampling locations.

#### 5.3.5 Ground Water Contamination.

There are currently thirty-seven (37) ground water monitoring wells in place on the Smith's Farm property: twenty (20) installed by USEPA for the Operable Unit One RI; eight (8) wells installed by Mrs. Smith around the permitted landfill; and nine (9) wells installed by Law Environmental, Inc., for the Operable Unit Two RI.

As part of the Operable Unit Two Remedial Investigation sampling, ground water samples were obtained from five (5) monitoring wells located within the landfill (MW-17, MW-21A, MW-22A, MW-22B and MW-24B). The remaining monitoring wells, installed as part of the Operable Unit Two investigation (MW-21B, MW-21C, MW-23A, MW-23B and MW-24A), were dry during both sampling events. See Figure 5.11.

The ground water in the intervals monitored by the above-mentioned wells is classified as Class III by USEPA's Ground Water Classification System. Water-bearing zones containing Class III ground water either contain water with a total dissolved solids content of greater than 10,000 mg/l or yield less than 150 gallons per day (24-hour period) per well, and typically are not considered potential drinking water sources. Generally, MCLs are not ARARs for Class III ground water systems, but may be ARARs under certain conditions (See Section 9.2.2.3.) and certainly may be used as a practical standard when no other standard is deemed pertinent.

Both barium and chromium exceeded the new Maximum Contaminant Level (MCL) for ground water at MW-17, which has a depth of 8.5 feet and collects liquid at the overburden/shale interface. However, based upon the available leachate and waste sampling data and the various indications of the shale's low permeability, barium and chromium are not considered to be indicators of ground water contamination from the landfill, but are considered to be indicators of leachate and leachate sediment contamination from the landfill.

Only one common monitoring well, MW-17, was sampled in the two remedial investigations. Concentrations of several inorganic constituents were higher in the 1989 Operable Unit One Remedial Investigation. In particular, cadmium and chromium exceeded drinking water MCLs. Lead (136 ppb) exceeded the Safe Drinking Water Act action level of 15 ppb. Results from the Operable Unit Two Remedial Investigation indicated that only lead exceeded the appropriate standard.

The on-site background well, MW-21A, which has a depth of 34.95 feet, was compared with private residential wells in the area. Generally the background concentrations of metals fell within the range of concentrations found in residential wells. Manganese was detected in the background monitoring well at 475 ppb compared to a maximum of 320 ppb in the residential wells. Magnesium was detected in the background well, MW-21A, at 144,000 ppb. The residential well concentrations ranged from 200 to 5,400 ppb. With the exception of magnesium, the background well results are very similar to the residential well data. Analytic results indicated no concentrations of PCBs and pesticides in ground water above risk-based levels.

#### 5.3.6 Summary of the Contamination in the Study Area.

Table 5.1 summarizes the concentration ranges of contaminants of potential concern found in certain media in the addressed by the Operable Unit Two Remedial Investigation.

Table 5.2 summarizes the exposure point concentrations for each contaminant of potential concern

in each medium for both current and future land uses.

Other than construction debris and municipal solid waste (MSW), which composes the volumetric majority of the material in the landfill, a wide variety of wastes were disposed of in the landfill. Samples from drums and waste unearthed during the landfill trenching into a geophysical anomaly in September 1990, reaffirm the presence of a wide variety of BTEX, ketones, VOCs, and inorganics. The same groups of chemicals and metals were found in the leachate in the pumphouse leachate sump in August 1990 and thereafter, although the heavier organics and the metals appear to drop out of the leachate stream between the appearance of the seep and the point at which the seep flows into the Unnamed Tributary east of the landfill. The data suggest that the Unnamed Tributary is minimally affected by the landfill leachate seeps that flow into it, although some sediments are contaminated with low levels of semi-volatile organic compounds and heavy metals. The leachate seep that drains the southwest quadrant of the landfill appears to have a weak intermittent flow which has caused some sediments to be contaminated with heavy metals. Surficial and shallow subsurface soils at the edge of the landfill are contaminated with low to moderate levels of heavy metals (e.g., cadmium, cobalt, copper, lead, vanadium, zinc) and very low levels of semi-volatile and volatile organic compounds. The delineation of several electromagnetic anomalies at greater subsurface depths and trenching to a depth of approximately twentyfive (25) feet near the northwest thermal anomaly indicate that the landfill waste is heterogeneous, with construction debris, residential and commercial trash, rusted drums, and bulk industrial liquid and solid waste, both nonhazardous and hazardous, having been mixed together. The volume of leachate which flows into the Unnamed Tributary is directly related to the amount of rainfall which has occurred.

## **6.0 SUMMARY OF SITE RISKS**

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment. This determination is based upon the information and conclusions presented in this ROD, including the following summary of Site risks (The Remedial Investigation Report, Volume III, December 1991, contains the risk assessment, the ecological assessment, and appendices, and is a part of the Administrative Record for the Site.).

### **6.1 HUMAN HEALTH RISKS**

A baseline human health assessment was conducted in order to determine the effects of existing conditions (i.e., the presence of inorganic and organic constituents at the formerly permitted landfill and in proximal areas) on the exposed and potentially exposed populations in and around the Site if no action is taken to remediate conditions at the Site. The baseline risk assessment provides the basis for taking action and indicates the exposure pathways that need to be addressed by the remedial action. This section of the ROD reports the results of the baseline risk assessment conducted for this site. The human health risk presentation herein conforms with guidance contained in the Risk Assessment Guidance for Superfund: Volume I: Human Health Evaluation Manual (Part A) (RAGS) (Interim Final, EPA/540/1-89/002, December 1989).

#### **6.1.1 Concentrations of Contaminants of Potential Concern in Each Medium of Exposure and Current and Future Land Use.**

The contaminants of potential concern for each medium investigated and a minimum-to-maximum concentration range associated with each contaminant of potential concern in each medium are summarized in Table 5.1. Contaminants of potential concern are those chemicals which appear in high enough concentrations in particular media, which can be attributed to on-site waste sources, and which may present a health hazard to humans, flora, and fauna which are exposed to

those media. The contaminants of potential concern are subjected to risk assessment procedures to determine those risks which need to be mitigated. Exposure point concentrations for chemicals of potential concern are listed in Table 5.2.

The formerly permitted landfill and the proximal areas addressed by Operable Unit Two activities are abandoned. Currently, the Smith's Farm property is not being used for either residential or commercial purposes. Residential development surrounds the Smith's Farm property. Immediately to the south is a mobile home park integrated with small, middle-class homes. To the east and west undeveloped land separates the Smith's Farm property from sparse residential development. To the north, north of Quick Cemetery, residential development is growing towards the northern edge of the Smith's Farm property. Given the Class III ground water sources at the Site, the flow of the Unnamed Tributary to the south and off of the Site, and the probable nearterm extension of public drinking water lines to the few remaining unconnected residences in the area, the use of surface water for household use poses the most immediate risk for off-site receptors. However, the concentrations of Site specific contaminants found in the Unnamed Tributary surface waters during several sampling and analysis events have been determined to be insignificant. The most substantial on-site risks are associated with leachate and leachate sediment.

The future use of the land surrounding the Smith's Farm property is expected to be residential. The very knobby, hilly topography could not easily support commercial development. Additionally, structures built in slopes or on hilltops would have to be anchored into the bedrock and structures built in the ravines would be subject to washouts during very heavy rains. The Smith's Farm property contains two major hazardous waste disposal areas. Each will, after remediation, be maintained for at least thirty (30) years. While the remaining Smith's Farm property may be available for residential or commercial development, this Record-of-Decision calls for deed restrictions, groundwater-use and land-use restrictions which will, along with the proximity of two hazardous waste disposal areas, tend to retard development.

#### 6.1.2 Summary of Results of Exposure Assessment.

The exposure routes considered are summarized in Table 6.0.

Special subpopulations exist. Children and adults ride through the Smith's Farm property on motorcycles and other types of recreational vehicles utilizing access provided by a power line easement which runs east-west across the northern part of the Smith's Farm property. Adults also use the property as a hunting and target-shooting area. Children sometimes play in the surface waters of the Unnamed Tributary, both on and off the Smith's Farm property; however, the surface waters are only deep enough for wading even at high water. The subpopulations are accommodated by the major exposure scenarios and pathways described in Table 6.0.

The exposure point concentrations for the current ground water use scenarios (i.e., use of residential wells for potable water by nearby residents) are based on the analytical results for the monitoring well that is closest to the trailer park (MW-17) which was sampled for the Operable Unit Two RI (Although MW-23 is closer to the trailer park, it did not produce water during either sampling event.). MW-17 is screened at the overburden rock interface and intercepts a leachate flow which is moving towards the Unnamed Tributary. MW-17 is more than 1,000 feet from the trailer park. The contaminant concentrations in water from MW-17 represent the RME for the trailer park, even though no contamination has been detected in the residential wells within the trailer park.

The recreational uses of Bluelick Creek and its tributaries are limited due to their size (typically 8 to 15 feet wide downstream of the landfill and 0.5 to 1 foot deep), although it is

assumed that residents may occasionally wade in, and children have been seen playing in the Creek. There are no permanent surface water intakes located along Bluelick Creek or Floyd's Fork (Kentucky Department of Health, 1990). The flow to the Creek and its tributaries is too low to support large aquatic life. The ingestion of fish from the Creek and tributaries was therefore not considered as a potential exposure pathway for trailer park residents in this evaluation. Although the Unnamed Tributary flows over bedrock and sediments are washed out and replaced after storms, there are pockets of sediments in the Creek bed that will be considered as exposure points in the risk assessment.

The Creek water may be used as a source of water for drinking, bathing or washing. A well is located adjacent to Bluelick Creek due west of the permitted landfill and upstream of any areas receiving drainage from the landfill. A small electric pump was observed in the Creek and upstream from the well. The pump system withdrew water from Bluelick Creek upgradient from the confluence of Bluelick Creek and the Unnamed Tributary and delivered the water to a residential lot via a pipeline (LAW, 1991). The use of the water is not known, although it is assumed to be used for household uses. While this small system is upstream of any potential Site-related contamination, it illustrates the use of surface water as potable water and the potential for similar uses downstream of areas receiving run-off or discharge from the Site.

Reportedly, hunting takes place on the Smith's Farm property. Some edible plants grow on the same property. Therefore, there is a potential for nearby residents and trespassers to ingest wildlife that may have been exposed to Site contamination or to vegetation that may have taken up Site contamination. The ability of contaminants to bioaccumulate in plant and animal tissue and the extent to which they may bioaccumulate vary according to chemical and organism exposed. Site-specific data are not available to adequately address the quantitative risk to such exposures. A survey to determine the type and volume of wildlife being hunted was not performed, although it is assumed that doves and other small animals are hunted occasionally for sport. However, their contribution to the diet of residents is expected to be minimal and insignificant. Therefore, these pathways were not quantified in the Risk Assessment.

The next step in the exposure assessment is to quantify the magnitude, frequency, and duration of exposure for the populations and exposure pathways selected for quantitative evaluation. This step is most often conducted in two stages: first, exposure point concentrations are estimated (Table 5.2); then, pathway-specific intakes are quantified. Intake variables and exposure point concentrations are selected so that the combination of all variables results in an estimate of the reasonable maximum exposure (RME) for each pathway. The RME is the maximum exposure that is reasonably expected to occur at a site.

Twenty (20) potential exposure pathways were selected and quantified in this assessment, including eight (8) current exposure pathways and twelve (12) future pathways. The major pathways quantified include the following:

#### Current Land Uses --- Off-Site Residents

1. Ingestion of drinking water
2. Dermal contact while showering
3. Inhalation of volatiles while showering
4. Dermal contact with surface water and stream sediments while wading
5. Dermal contact with leachate water and sediments while on-site
6. Inhalation of contaminants in fugitive dust
7. Incidental ingestion of surface soils
8. Dermal contact with surface soils

#### Future Land Uses --- On-Site and Off-Site Residents

9. Ingestion of drinking water
10. Dermal contact while showering
11. Inhalation of volatiles while showering
12. Dermal contact with leachate water and sediments
13. Dermal contact with surface soils
14. Inhalation of contaminants in fugitive dust
15. Incidental ingestion of surface soils
16. Dermal contact with surface water and stream sediments while wading

#### Future Land Uses --- On-Site Workers

17. Dermal contact with surface and subsurface soils
18. Incidental ingestion of surface and subsurface soils
19. Inhalation of fugitive dust from surface and subsurface soils
20. Dermal contact with leachate water and sediment

Exposure point concentrations for each of the above-mentioned pathways were determined based on the results of current monitoring data from sampling locations on-site. The exposure point concentrations are multiplied by pathway-specific intake assumptions to yield quantitative estimates of chemical intakes for each pathway. Exposure was quantified through the use of the standard exposure factors and scenarios as defined in Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (OSWER Directive 9285.6-03). Table 5.2 summarizes the exposure point concentrations for each contaminant of potential concern in each medium for both current and future land uses. Chemical-specific intake estimates are presented, by pathway, in Section 3.0 and Appendix C of Volume III, the Risk Assessment, of the Operable Unit Two Remedial Investigation Report. Table 6.1 describes the major assumptions about exposure frequency and exposure duration. More detailed information on the exposure assessment may be found in Section 3.0 of the above-mentioned Risk Assessment. 6.1.3 Summary of the Toxicity Assessment of Contaminants of Concern.

The USEPA has developed toxicity values which reflect the magnitude of the adverse noncarcinogenic and carcinogenic effects from exposure to specific chemicals. Abbreviated descriptions of the development of the toxicity values follow.

##### 6.1.3.1 Noncarcinogenic Effects

Chemicals that give rise to toxic endpoints other than cancer and gene mutations are often referred to as "systemic toxicants" because of their effects on the function of various organ systems. Chemicals considered to be carcinogenic can also exhibit systemic toxicity effects. For many noncarcinogenic effects, protective mechanisms (i.e., exposure or dose thresholds) are believed to exist that must be overcome before an adverse effect is manifested. This characteristic distinguishes systemic toxicants from carcinogens and mutagens which are often treated as acting without a distinct threshold. As a result, a range of exposure exists from zero to some finite value that can be tolerated with essentially no chance of the organism expressing adverse effects. In developing toxicity values for evaluating noncarcinogenic effects, the standard approach is to identify the upper bound of this tolerance range or threshold and to establish the toxicity values based on this threshold.

The toxicity value most often used in evaluating noncarcinogenic effects is a Reference Dose (RfD) for oral or dermal exposure, or Reference Concentration (RfC) for inhalation exposure. Various types of RfDs/RfCs are available, depending on (1) the exposure route of concern (e.g., oral or inhalation), (2) the critical effect of the chemical (e.g., developmental or other), and (3) the length of exposure being evaluated (e.g., chronic or subchronic).

Reference Doses (RfDs) have been developed by USEPA for indicating the potential for adverse health effects from exposure to contaminant(s) of concern exhibiting noncarcinogenic effects. A chronic RfD/RfC is defined as an estimate of a daily exposure level for the human population that is likely to be without appreciable risk of deleterious effects during a lifetime. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure limits for humans, including sensitive individuals. Estimated intakes of contaminant(s) of concern from environmental media (e.g., the amount of a contaminant(s) of concern ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). Chronic RfDs/RfCs are specifically developed to be protective for long-term exposures, i.e., seven years to a lifetime (seventy [70] years). All exposures except childhood exposures in this preliminary risk evaluation are assumed to be long-term. The chronic RfDs/RfCs for the chemicals of concern at this site are presented in Table 6.2 are derived from USEPA's Integrated Risk Information System (IRIS), 1991. The oral and inhalation RfDs shown in Table 6.2 are derived from USEPA's Health Effects Assessment Summary Tables (HEAST, 1991).

Noncarcinogenic effects are characterized by comparing the estimated chemical intakes to the appropriate RfD/RfC value. The RfD/RfC value is, by definition, an estimate of a daily exposure level for the human population that is likely to be without appreciable risk of deleterious effects during a lifetime. Therefore, when the estimated chronic daily intake of a chemical exceeds the appropriate RfD/RfC, the ratio of exposure to toxicity, there may be a concern for potential noncancer effects from exposure to that chemical. The ratio of the chronic daily intake to the chronic RfD/RfC is the "Hazard Quotient". The sum of the Non-cancer HQ = CDI/RfD

where:

CDI = Chronic Daily Intake

RfD = reference dose; and

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

Hazard Quotients for each chemical in a specific pathway is the "Hazard Index (HI)". By adding HQs for all contaminant(s) of concern that affects the same target organ (e.g., liver) within a medium or across all media to which a given population may reasonably be exposed, a Hazard Index can be generated. It is important to note that the Hazard Quotient does not represent a statistical probability; a ratio of 0.01 does not mean that there is a one (1) in one hundred (100) chance of the effect occurring. Rather, a Hazard Quotient greater than 1.0 indicates that the "threshold" for that chemical has been exceeded. The chemical-specific Hazard Quotient calculations are presented by pathway in Appendix C of Volume III, the Risk Assessment, of the Operable Unit

Two Remedial Investigation.

USEPA assumes additivity of effects in evaluating noncarcinogenic effects from a mixture of chemicals. The chemical-specific Hazard Quotients are summed to yield an overall pathway Hazard Index; pathway Hazard Indices are then summed to yield a total risk for each relevant population. A sum totaling greater than 1.0 indicates that the threshold or departure point for that pathway or pathway-population has been exceeded.

#### 6.1.3.2 Carcinogenic Effects

Carcinogenesis, unlike many noncarcinogenic health effects, is generally thought to be a

nonthreshold effect. In other words, USEPA assumes that a small number of molecular events can cause changes in a single cell that can lead to uncontrolled cellular growth. This hypothesized mechanism for carcinogenesis is referred to as "nonthreshold", because there is believed to be essentially no level of exposure to such a chemical that does not pose a finite probability of generating a carcinogenic response.

To evaluate carcinogenic effects, USEPA uses a two-part evaluation in which the chemical is first assigned a weight-of-evidence classification, and then a Carcinogenic Slope Factor (CSF) is calculated. These Indices can be derived for either oral or inhalation exposures. The weight-of-evidence classification is based upon an evaluation of the available data to determine the likelihood that the chemical is a human carcinogen. Chemicals with the strongest evidence of human carcinogenicity are denoted with Class A, B1, or B2, while chemicals with less supporting evidence are classified as C or D.

USEPA Weight-of-Evidence  
Classification System for  
Carcinogenicity

Group	Description
A	Human carcinogen
B	Probable human carcinogen
B1	Limited data are available
B2	Sufficient evidence in animals and inadequate or no evidence in humans
C	Possible human carcinogen
D	Not classifiable as to human carcinogenicity
E	Evidence of noncarcinogenicity for humans

The Slope Factor quantitatively defines the relationship between the dose and the response. SFs have been developed by USEPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic contaminants of concern. SFs, which are expressed in units of (mg/kg-day)<sup>-1</sup>, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The Slope Factor is generally expressed as a plausible upper-bound estimate of the probability of response occurring per unit of chemical. The term "upperbound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Slope Factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-animal extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). The Carcinogenic Slope Factors for the chemicals of concern at this site are presented in Table 6.2. These Slope Factors are derived from USEPA's Health Effects Assessment Summary Tables (HEAST, 1991).

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a life-time as a result of exposure to the carcinogen. Excess life-time cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where:

risk = a unitless probability (e.g.,  $2 \times 10^{-5}$ )

CDI = chronic daily intake averaged over 70 years (mg/kg-day); and

SF = slope-factor, expressed as (mg/kg-day)[-1]

These risks are probabilities that are generally expressed in scientific notation (e.g.,  $1 \times 10^{-6}$  or 1E-06). An excess lifetime cancer risk of  $1 \times 10^{-6}$  indicates that, as a reasonable maximum estimate, an individual has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

#### 6.1.3.3 Dermal Exposures

No RfDs or CSFs have been derived for dermal absorption. Risks associated with dermal exposures may be evaluated with Oral Absorbed Dose RfDs or Oral Absorbed Slope Factors after dermal exposures are converted to their respective absorbed dose. Dermal exposures were adjusted to absorbed dose estimates by assuming that the contaminants permeate skin at chemical-specific permeability rates. Permeability constants are listed on the Risk Characterization Tables in Appendix C of the Risk Assessment, Volume III, Remedial Investigation Report, December 1991. Oral RfDs and CSFs were also adjusted by the default oral absorption rate of five (5) percent, which was given in the Risk Assessment Guidance (RAGS) and which gives an Absorbed Dose RfD or Absorbed Dose CSF. The Dermal Absorbed Dose intakes can then be compared to Absorbed Dose toxicity values, as described in the Risk Assessment Guidance for Superfund (RAGS).

#### 6.1.4 Summary of Risk Characterization of Each Pathway and the Total Risk for the Site.

The risk characterization integrates the results of the exposure and toxicity assessments into quantitative and qualitative expressions of risk. To characterize potential noncarcinogenic effects, comparisons are made between the estimated chemical intakes and the RfDs/RfCs for those chemicals; to characterize potential carcinogenic effects, estimated chemical intakes are multiplied by the chemical-specific Slope Factors to yield chemical-specific dose-response information. A summary of Site major risks totals is set forth in Tables 6.3a and 6.3b. Noncarcinogenic hazard indices totals greater than 1.0 also indicate that remedial action may need to be implemented. Carcinogenic risk totals for each receptor greater than  $10^{-6}$  (or greater than a 1 in 1,000,000 chance of getting a cancer solely because of the described exposure) indicate that remedial action may be called for.

##### 6.1.4.1 Potential or Actual Carcinogenic Risks

###### 6.1.4.1.1 Current Carcinogenic Risks for Residential Populations

Surface Water - The carcinogenic risk from ingestion of surface water by current residential adults ( $4 \times 10^{-4}$ ) exceeds the acceptable upperbound risk range of  $10^{-6}$  to  $10^{-4}$  chance of developing cancer as a result of Site related exposure to a carcinogen in surface water over a seventy (70) year lifetime under the specific exposure conditions at the Site. This means an upperbound number, given the concentrations of particular contaminants and the exposure described, out of ten thousand exposed humans, toxicologists would expect that four (4) additional or "excess" exposed humans would be inflicted with cancer. This risk is attributed to N-Nitrosodi-n-propylamine, which was detected in only one of three (3) samples from locations potentially used for potable water sources. The reported concentration was estimated. Additionally, this constituent was not detected in any other medium at the Site. The exclusion of this data point would result in a risk of  $3 \times 10^{-7}$ . Additionally, the conservative assumptions used in the calculation of risk via this pathway (i.e., one hundred [100] percent of drinking water comes from surface water sources) may have contributed to a high risk, as publicly supplied potable water is available to most residents.

The carcinogenic risks to residential adults from recreational exposure to surface waters via

dermal contact while wading and viadermal contact during showers and household use fall in the acceptable range. Because of their insignificant concentrations in the surface waters, volatileorganics were excluded as chemicals of concern for this pathway, so there is no quantitative estimate of carcinogenic risk from current exposure to surface water via inhalation.

Ground Water - There were no carcinogenic health criteria available for any of the constituents of concern evaluated for risk to current residents from the use of ground water as potable water. Therefore, there is no quantitative estimate of carcinogenic risk from current exposure to ground water via ingestion, inhalation, or dermal exposure.

Stream Sediments - The risk of exposure to current residential adults and children via dermal contact with stream sediments falls within the acceptable cancer risk range.

Surface Soils - The calculated carcinogenic risks for current residential exposure (adults and children) to surface soil via ingestion, dermal contact, and inhalation of fugitive dust are all within the acceptable range.

Leachate Water - The current carcinogenic risk associated with dermal exposure to leachate water by residential adults falls within the  $10^{-4}$  to  $10^{-6}$  cancer risk range.

Leachate Sediments - The current carcinogenic risk associated with dermal exposure to leachate sediments by residential adults exceeds the acceptable risk. The calculated risk may be artificially high, as conservative assumptions were used in calculating dermal risk. Risk via dermal contact was calculated assuming one hundred (100) percent dermal absorption from the leachate sediments, and a five (5) percent oral absorption efficiency in adjusting the oral RfD to a dermal RfD. Additionally, the constituent concentrations detected in LW-08/LS-08 were extremely high and impacted heavily on the calculation of exposure point concentrations. This sample location is located in an area of partially buried drums on the landfill.

#### 6.1.4.1.2 Future Carcinogenic Risks for Residential and Occupational Adult Populations

Surface Water - The carcinogenic risk from ingestion of surface water by future residential adults exceeds the acceptable  $10^{-4}$  to  $10^{-6}$  risk range. The greatest portion of the risk is attributed to N-Nitrosodi-npropylamine, which was detected in only one of five (5) samples. The reported concentration was estimated. The exclusion of this data point would result in an upperbound carcinogenic risk of  $3 \times 10^{-7}$ .

The carcinogenic risks to residential adults from exposure via dermal contact with surface water used as potable water and from recreational exposure to surface waters while wading fall in the acceptable risk range. Because of their insignificant concentrations in the surface waters, volatile organics were excluded as chemicals of concern for this pathway, so there is no quantitative estimate of carcinogenic risk from future exposure to surface water via inhalation.

Ground Water - The carcinogenic risk to residential adults from potential use of on-Site ground water as drinking water exceeds the acceptable cancer risk. The greatest portion of the risk is attributed to N-Nitrosodi-npropylamine, which was detected in only one (1) of four (4) samples (MW-24B). It was assumed that one hundred (100) percent of an individual's drinking water comes from ground water. However, the ground water is of poor quality, the aquifers under and near the Site having been classified "Class C" or Class III, unsuitable for use as drinking water. Publicly supplied water is currently available to virtually all the residences in the area.

Based upon current Site-specific data, the inhalation of volatiles and dermal exposure during showering and household use by future residents do not pose a carcinogenic risk. Future risks

associated with ground water exposure do not involve the assumption that the constituent concentrations will remain the same and do not account for decay, degradation, and attenuation of contaminants over time.

Stream Sediments - The risk of exposure to future residential and occupational adults via dermal contact with stream sediments immediately proximal to the formerly permitted landfill falls within the acceptable cancer risk range.

Surface Soils - The calculated carcinogenic risks for future exposure of residential adults and children and occupational adults to surface soil via ingestion, dermal contact, and inhalation of fugitive dust are all within the acceptable range. Based upon current Site-specific data, there is no unacceptable carcinogenic risk from exposure to surface soil via these pathways.

Subsurface Soils - The carcinogenic risks to future occupational workers from exposure to constituents in subsurface soils via incidental ingestion, dermal contact, and inhalation of fugitive dust fall within the acceptable range.

Leachate Water - The future carcinogenic risks associated with dermal exposure to leachate water by residential adults and occupational works fall within the acceptable risk range.

Leachate Sediments - The current carcinogenic risks associated with dermal exposure to leachate sediments by residential and occupational adults exceed the acceptable risk. Conservative assumptions were used in calculating dermal risk and the constituent concentrations detected in LS-08 impacted heavily on the calculation of exposure point concentrations, as previously discussed. The calculation of future risks assumes no attenuation of constituent concentrations.

#### 6.1.4.2 Noncarcinogenic Risks.

##### 6.1.4.2.1 Current Noncarcinogenic Risk

Currently exposed populations include nearby residents (adults and children) and trespassers only. The media-specific risks, by pathway, are presented as follows.

Surface Water - The chronic Hazard Indices total for ingestion of surface water used as potable water and for dermal exposure via wading and during showers and household use falls below the Hazard Index departure point of 1.0 for both residential adults and children. Therefore, based upon current Site data, there is no evidence of unacceptable risks to persons using surface water for bathing and household use, and for wading.

Because of their insignificant concentrations, volatile organics were not selected as chemicals of concern for exposure via inhalation during showers and household use. Therefore, no Hazard Index was calculated for exposure via this pathway.

Ground Water - The Hazard Indices total for current exposure to ground water via ingestion by residential adults and children exceed the departure point of 1.0. Antimony and thallium pose the greatest risk of exposure to both receptors via this pathway, which would otherwise be acceptable. The use of MW17 for the exposure calculation is required, but a conservative procedure, as it contained the highest concentrations of all on-Site monitoring wells sampled for the Operable Unit Two Remedial Investigation. This well is screened at the rock/overburden interface and intercepts a leachate flow. The use of this shallow water for drinking water is neither advisable nor feasible.

The risk of dermal exposure and inhalation of chemicals in ground water used for potable water

by current residential adults and children falls below the departure point of 1.0. Therefore, based on current Site data, there is no evidence of unacceptable risks to persons using surface water for bathing, for household use, and for wading.

Stream Sediments - The Hazard Indices total for exposure of current residential adults and children to stream sediments via dermal contact falls below the departure point of 1.0. Therefore, an unacceptable risk from current exposure to stream sediments does not exist.

Surface Soils - The calculated Hazard Indices total for noncarcinogenic effects of exposure of current residential adults and children to surface soil via ingestion and via inhalation of fugitive dust is below the departure point of 1.0. Based upon current Site-specific data, there is no unacceptable noncarcinogenic risk from exposure to surface soil via these pathways.

The Hazard Indices total for exposure of these receptors via dermal absorption exceeds the departure point of 1.0. The risk is attributed to the presence of alpha- and gamma-chlordane detected in one (1) surface soil sample. The reported concentrations of these constituents were analytically estimated. Further, these constituents were not found in any other media at the Site. The Hazard Indices total for dermal exposure was calculated using the idealized assumption that a one hundred (100) percent dermal absorption efficiency occurred.

Leachate Water - The Hazard Indices total for current noncarcinogenic risk associated with dermal exposure to leachate water by residential adults and children exceeds the departure point of 1.0 for acceptable risk. Additionally, the constituent concentrations detected in LW-08 were extremely high and impacted heavily on the calculation of exposure point concentrations. The calculation of future risk also assumes no attenuation of constituent concentrations.

Leachate Sediments - The Hazard Indices total for current noncarcinogenic risk associated with dermal exposure to leachate sediments by residential adults and children falls below the departure point of 1.0.

#### 6.1.4.2.2 Future Noncarcinogenic Risk for Nearby Residents, Onsite Residents, and Construction Workers

Surface Water - The chronic Hazard Indices total is less than 1.0 for ingestion and dermal exposure during showers and household use and for recreational dermal exposure while wading for both residential adults and children. Therefore, based upon current Site data, there is no evidence of unacceptable systemic risks to persons who may use surface water for bathing and household use, and for wading. Volatile organics (VOCs) were determined not to be chemicals of concern for this pathway. Therefore, no Hazard Index was calculated for exposure via inhalation of VOCs during showers and household use.

Ground Water - The Hazard Indices total for future exposure to ground water via ingestion of drinking water by residential adults and children exceeds the departure point of 1.0. The risk is attributed to the presence of heavy metals in the ground water. Reduction of constituent concentrations through decay, degradation, and attenuation are not accounted for. As previously discussed, both the shallow and the deep ground water in this area is of poor quality and undesirable as a potable water source.

The Hazard Indices total for inhalation of volatiles and dermal contact with ground water during household use by residential adults and children falls below the departure point. Therefore, based on the Site-specific data, there is no evident risk of exposure via these pathways.

Stream Sediments - The Hazard Indices total for exposure of future residential adults and children and future occupational workers to stream sediments via dermal contact falls below the

departure point of 1.0. Therefore, there is no unacceptable systemic risk from dermal exposure to stream sediments.

Surface Soils - The calculated Hazard Indices total for noncarcinogenic effects of exposure of future residential adults and children and future occupational workers to surface soil via ingestion, and via inhalation of fugitive dust is within the acceptable range. Based upon current Site-specific data, and assuming no increase in constituent concentrations, there are no unacceptable systemic risks from exposure to surface soil via these pathways.

The Hazard Indices total for exposure of future residential adults and children via dermal absorption exceeds the departure point of 1.0. The risk is attributed to chlordanes detected in surface soil. The Hazard Indices for dermal exposure were calculated using the required conservative assumptions. The Hazard Index for exposure of occupational workers to surface soil via dermal contact falls below the departure point of 1.0.

Subsurface Soils - The calculated Hazard Indices total for noncarcinogenic effects of exposure to future occupational workers to constituents in subsurface soil via incidental ingestion, dermal contact, or inhalation of fugitive dust falls within the acceptable range. Therefore, based upon current Site-specific data, and assuming that concentrations will not increase in the future, there are no unacceptable systemic risks from exposure to subsurface soil via these pathways.

Leachate Water - The Hazard Indices total for future risk associated with dermal exposure to leachate water by residential adults and children and occupational adults exceeds the departure point for acceptable risk. The constituent concentrations detected in sample LW-08 were extremely high and heavily impacted the calculation of exposure point concentrations.

Leachate Sediments - The Hazard Indices total for future noncarcinogenic risk associated with dermal exposure to leachate sediments by residential adults and children and occupational adults falls below the departure point of 1.0.

#### 6.1.4.3 Summary

The major carcinogenic risks for current residential adults are from ingestion of surface water, dermal exposure with surface soils, and dermal exposure with leachate sediment. Secondary potential or actual carcinogenic risks for current residential adults are from dermal exposure to surface water and to leachate water. The major carcinogenic risks for future residential adults are from ingestion of surface water, ingestion of ground water and dermal exposure to surface soil and to leachate sediment. Secondary carcinogenic risks are from dermal exposure to surface water, ground water, and leachate water. The major potential or actual carcinogenic risk for future occupational adults (on-site workers) is from dermal exposure to leachate sediment.

The major noncarcinogenic risk for all categories of human receptors is from dermal exposure to leachate water; however, the future occupational adult has a high risk associated with this type of exposure.

Tables 6.4 a and b summarize the major Site risks based on current and future land use, respectively. Those are the immediate risks to be mitigated by the selected remedy. The tables include risks for each chemical that contributes to a pathway that exceeds a  $1 \times 10^{-4}$  carcinogenic risk or a Hazard Index of 1.0 or greater. Chemicals contributing risk to these pathways are not included if their individual carcinogenic risk contribution is less than  $1 \times 10^{-6}$  or their noncarcinogenic Hazard Quotient is less than 0.1.

Actual or threatened releases of hazardous substances from this site, if not addressed by

implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

## 6.2 ENVIRONMENTAL EVALUATION

Potential ecological receptors present in the vicinity of the Site and potential pathways by which these receptors might be exposed to chemicals of concern present in surface soils, leachate, surface water, and stream sediments were identified. Risks to environmental receptors arising from exposure to Site constituents were characterized. Potential receptors are: terrestrial vegetation, terrestrial wildlife, endangered and threatened species, aquatic wildlife, and aquatic vegetation. For additional information on endangered and threatened species, see Section 7.6.2 herein.

Sources of uncertainty in the determination of the ecological qualitative risk assessment include: (a) confidence that all key contaminants were identified and quantified accurately;

(b) dependence on toxicity data which are the foundation for all health-based ARARs and which are based on animal experiments and epidemiological study groups;

(c) confidence in the identification of all exposure parameters and exposure pathways appropriate to the site;

(d) uncertainty in the comparison of site concentrations to ARARs by which additive effects may be overlooked;

(e) confidence in the identification and characterization of the exposed populations, both current and future, and the land use, both current and future;

(f) qualitative risk assessments which rely on background concentrations and chemical - specific ARARs are somewhat limited in that they cannot account for cumulative toxic effects from several chemicals or several exposure routes; and

(g) the imprecision of present scientific data on exactly what constituent concentrations pose a hazard to environmental receptors.

### 6.2.1 Summary of the Affects of the Contamination on Habitats.

Any negative impacts on terrestrial flora and fauna by the contaminants of concern are not readily apparent. Aquatic life in Bluelick Creek and the Unnamed Tributary may potentially suffer negative impacts from constituents currently detected in leachate water and leachate sediment which discharge to surface waters. However, the natural character of the streams and pools, i.e., the intermittent flow and the poor water quality, does not readily support aquatic life. Tables 6.5 and 6.6 compare surface water and surface water sediment quality criteria to existing concentrations in these two media. Terrestrial and riparian communities periodically utilizing intermittent streams for a water source or habitat may be negatively impacted by constituent concentrations in stream waters, sediments and leachate reaching surface waters. As the rate of flow is generally low in intermittent streams adjacent to the Site, the level of exposure is expected to be low to moderate. Based upon seasonal flow rates, surface water impacts are expected to be minimal.

### 6.2.2 Summary of the Affects of the Contamination on Any Endangered Species.

Effects upon endangered and threatened species in the Site area have not been detected. If a threatened or endangered species is identified as a receptor, or potential receptor, then the

Ecological Risk Assessment will be revised to consider the Site-related impacts on an individual of the status species. The U.S. Department of the Interior, Fish and Wildlife Service, has not granted a release from potential environmental damages under the Endangered Species Act or under any other law or regulation.

## **7.0 DESCRIPTION OF ALTERNATIVES**

In the Operable Unit Two Feasibility Study numerous alternatives for remediation were developed and then screened based upon five (5) major categories of action: 1) no-action; 2) institutional action; 3) containment; 4) treatment; and 5) disposal. An individual analysis of alternatives was then made against two (2) threshold evaluation criteria: 1) overall protection of human health and the environment and 2) compliance with ARARs. Surviving alternatives were subjected to a comparative analysis of the alternatives based upon five (5) modifying evaluation criteria: 1) long-term effectiveness and permanence; 2) reduction of toxicity, mobility, and volume through treatment; 3) short-term effectiveness; 4) implementability; and 5) cost. This process resulted in five (5) major types of remedial actions being retained for further consideration: 1) no-action; 2) limited institutional actions; 3) RCRA-type cap, actions in peripheral areas, actions in electromagnetic anomalies; 4) collection and treatment of leachate; and 5) actions to extinguish thermal anomalies.

These five (5) major types of remedial actions were subdivided into a total of fourteen (14) subtypes based upon site-specific applicability, known availability, and proven performance; remedial action types 3), 4), and 5) above were comprised of five (5), four (4), and three (3) subtypes, respectively. A summary of these fourteen (14) subtypes, including their respective capital costs and thirty (30) year O&M costs, is presented in Attachment 7.0. From these subtypes five (5) alternatives were constructed. Alternative I was no-action, a baseline alternative which is required to be evaluated. The other four (4) alternatives addressed the different threats at the landfill to varying degrees and in different manners. In May 1992, Alternative III was presented to the public and Kentucky as USEPA's proposed plan for cleanup. After the public comment period and Kentucky's concurrence with the proposed plan, two (2) additional criteria were assessed: 1) state acceptance and 2) community acceptance. Alternative III was selected as the remedy taking into consideration the threshold evaluation criteria, the modifying evaluation criteria, and comments from the community and the Commonwealth of Kentucky. A description of each of the five (5) alternatives which were considered follows. A more detailed description of the alternatives can be found in the final Feasibility Study Report for Operable Unit Two, located in the Administrative Record.

### **7.1 ALTERNATIVE I - NO ACTION**

#### **7.1.1 Treatment Component.**

There would be no treatment under this alternative.

#### **7.1.2 Containment Component.**

There would be no containment efforts under this alternative.

#### **7.1.3 General Components.**

The no-action alternative provides for a range of activities from no-action whatsoever (i.e., the "do nothing" approach) to the same package of institutional actions which are components of Alternatives II, III, IV, and V. From a practical standpoint the landfill would, at the very least, have to be monitored. It would be realistic and appropriate to order that the leachate seeps, surface waters, and monitoring wells be monitored. For the purposes of this discussion,

however, no action means that no additional actions would be taken.

#### 7.1.4 Major ARARs.

This alternative does not comply with RCRA Subtitle C landfill closure requirements, because there would be no cap/cover and no leachate collection and treatment system. The State requirements which reflect those in RCRA Subtitle C would not be satisfied either. RCRA LDRs would not be a factor because landfill electromagnetic anomalies would not be excavated and, therefore, placement would not occur. The leachate seeps would not be remediated; therefore, the federal and state Ambient Water Quality Criteria (AWQC) for surface waters would probably not be satisfied where the seeps entered the Unnamed Tributary. The substantive requirements for a Kentucky Pollution Discharge Elimination System (KPDES) or National Pollution Discharge Elimination System (NPDES) permit would not be able to be met with only physical treatment of leachate. The landfill thermal anomalies would not be remediated and landfill consolidation would not occur, so the National Ambient Air Quality Standards (NAAQS) of the Clean Air Act (CAA) would not be pertinent. Monitoring ground water quality for comparison to the Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) and surface waters for comparison to federal and state AWQC would probably be required.

### 7.2 ALTERNATIVE II - LEACHATE COLLECTION AND TREATMENT

#### 7.2.1 Treatment Component.

A leachate collection system as described in Figure 9.1 and in Attachments 7.1 and 7.5 would be constructed. Perforated piping in gravel-lined ditches along the east and south sides of the landfill will collect and direct leachate to a leachate treatment plant at the southeastern corner of the landfill near the Unnamed Tributary. Collected leachate would be treated only by physical processes, such as sedimentation and filtration, and the effluent discharged on-site to the Unnamed Tributary. The substantive requirements of a KPDES (NPDES) permit would, nevertheless, have to be met. The subsurface thermal anomalies would be remediated by excavation and open air combustion until extinguished. A water spray could also be used to hasten the quenching of the thermal anomaly.

#### 7.2.2 Containment Component.

A leachate collection and treatment system as mentioned in Section 7.2.1 above would be constructed to intercept, collect, and contain leachate moving through waste towards the Unnamed Tributary, and other areas downgradient from the landfill (See Figure 9.1.).

No consolidation of landfill material would be undertaken. No new cap/cover would be installed. The surface of the landfill would be left as is. Leachate would be contained within the leachate collection and treatment system. Sludge from the leachate collection and treatment system would be containerized and properly disposed of.

#### 7.2.3 General Components.

Monitoring of the leachate treatment system effluent would be performed monthly for the first year after construction is complete, quarterly for the second year, and semi-annually thereafter for the next twenty-eight (28) years; however, this monitoring schedule may be modified by USEPA during the Remedial Design phase. Sampling and full-scan (TCL/TAL) analysis of Operable Unit Two ground water monitoring wells would be performed semi-annually for the first five (5) years and then annually for the next twenty-five (25) years. The frequency and character of sampling and analysis may be modified by the USEPA at any time.

A perimeter fence, lockable gates, warning signs and other security measures would be installed around the landfill and the leachate treatment plant.

Water-use restrictions for ground water and surface water would be imposed in the immediate area of the landfill.

Deed restrictions would be imposed to restrict future land-use. The landfill and the immediate area should not be utilized for residential or commercial building. 7.2.4 Major ARARs.

This alternative would comply with some, but not all of the RCRA Subtitle C requirements for landfill closure. The requirement for a cap would not be satisfied, because there would be no cap. The surface of the landfill would be left as is. However, leachate would be collected and subjected to physical treatment processes only. Therefore, the federal and state AWQC (CWA) for organics in surface waters would not be satisfied at the point in the Unnamed Tributary where the discharge would occur. The use of only physical leachate treatment processes would allow many organics to move through the treatment machinery and be discharged into the Unnamed Tributary; thus, the substantive requirements of a KPDES permit, which is based upon AWQC and other criteria, would not be satisfied. The landfill thermal anomalies would not be remediated and there would be no consolidation of the landfill's peripheral areas, so the CAA NAAQS would not be invoked. Long-term monitoring of Site ground water, surface water, and the KPDES discharge would be accomplished.

### 7.3 ALTERNATIVE III - CONSOLIDATION OF LANDFILL WASTE, CAP AND COVER, LEACHATE COLLECTION AND TREATMENT

#### 7.3.1 Treatment Component.

A leachate treatment plant incorporating physical treatment (such as filtration and aeration) and chemical treatment systems (such as the addition of polymers and aluminum sulfate to promote coagulation) would be built to the southeast of the landfill. Leachate treatment effluent would be discharged onsite to the Unnamed Tributary. The substantive requirements of a KPDES (NPDES) permit would, nevertheless, be required to be met.

The subsurface thermal anomalies would be excavated and allowed to open air burn until extinguished. A water spray may be used to hasten the elimination of the combustion.

#### 7.3.2 Containment Component.

A leachate collection and treatment system as described in Section 7.3.1 above and in Attachments 7.2 and 7.5 would be constructed to intercept, collect, and contain leachate moving through waste towards the Unnamed Tributary, and other areas downgradient from the landfill (Figure 9.1). Sludge from the leachate collection and treatment system would be containerized and properly disposed.

Contiguous Areas A and B (Figure 9.0) would be consolidated within the landfill and the surface of the landfill would be contoured. The areal extent of contamination in Areas A and B would be determined by a thorough surface and subsurface grid sampling effort during the Remedial Design phase.

A RCRA-type cap and cover with engineered run-on and run-off systems would be installed over the approximately thirty (30) acre area which constitutes the main landfill.

#### 7.3.3 General Components.

Monitoring of the leachate treatment system effluent would be performed monthly for the first year after construction is complete, quarterly for the second year, and semi-annually thereafter for the next twenty-eight (28) years; however, this monitoring schedule may be modified during the Remedial Design phase. Sampling and full-scan (TCL/TAL) analysis of Operable Unit Two ground water monitoring wells would be performed semi-annually for the first five (5) years and then annually for the next twenty-five (25) years. The frequency and character of sampling and analysis may be modified by the USEPA at any time.

A perimeter fence, lockable gates, warning signs and other security measures would be installed around the landfill and the leachate treatment plant.

Water-use restrictions for ground water and surface water would be imposed in the immediate area of the landfill. Deed restrictions would be imposed to restrict future land-use. The landfill and the immediate area should not be utilized for residential or commercial building.

#### 7.3.4 Major ARARs.

This alternative would comply with the requirements of RCRA Subtitle C for landfill closure. Certain peripheral areas of the landfill would be consolidated into the main part of the landfill. The landfill thermal anomalies will be extinguished by excavation, open burning, and quenching with water spray. During the consolidation and thermal anomaly extinguishing, measures will be taken to satisfy the requirements in the CAA NAAQS (Section 112) pertaining to fugitive emissions. The RCRA cap/cover would have a composite hydraulic permeability of at least  $10^{-7}$  cm/sec and would have both an HDPE liner as well as either two feet of compacted clay or a layer of bentonite matting. The cover would be contoured so as to reduce erosion and potential washout damage to the surrounding area. A leachate collection and treatment system will be installed. The treatment system will have both physical and chemical treatment stages, and a biological treatment stage, if it is necessary to reduce concentrations of certain VOCs to very low levels before discharge. The substantive requirements of a KPDES permit would be satisfied. The discharge to the Unnamed Tributary would have to meet the AWQC for surface water.

### 7.4 ALTERNATIVE IV - STABILIZATION OF LANDFILL ANOMALIES, CONSOLIDATION OF LANDFILL WASTE, LEACHATE COLLECTION AND TREATMENT, CAP AND COVER

#### 7.4.1 Treatment Component.

A leachate treatment plant incorporating physical treatment (such as filtration and aeration) and chemical treatment systems (such as the addition of polymers and aluminum sulfate to promote coagulation) would be built to the southeast of the landfill. A biological treatment stage would be included, if necessary. Leachate treatment effluent would be discharged on-site to the Unnamed Tributary. The substantive requirements of a KPDES (NPDES) permit would, nevertheless, be required to be met.

The subsurface thermal anomalies would be extinguished by injecting water into them thereby displacing subsurface oxygen and quenching the combustion. The thermal anomalies would not be excavated during this process.

The major electromagnetic anomalies would be excavated and the waste from them subjected to on-site stabilization/solidification in order to immobilize both organic and metallic contaminants. The stabilized waste would be redeposited in the landfill.

#### 7.4.2 Containment Component.

A leachate collection and treatment system as described in Section 7.4.1 above and in

Attachments 7.3 and 7.5 and would be constructed to intercept, collect, and contain leachate which had moved through waste towards the Unnamed Tributary, and other areas downgradient from the landfill (See Figure 9.1). Sludge from the leachate collection and treatment system would be containerized and properly disposed.

Contiguous Areas A and B (Figure 9.0) would be consolidated within the landfill and the surface of the landfill contoured. The areal extent of contamination in Areas A and B would be determined by a thorough surface and subsurface grid sampling effort during the Remedial Design phase.

A RCRA-type cap and cover with engineered run-on and run-off systems would be installed over the approximately thirty (30) acre area which constitutes the main landfill.

#### 7.4.3 General Components.

Monitoring of the leachate treatment system effluent would be performed monthly for the first year after construction is complete, quarterly for the second year, and semi-annually thereafter for the next twenty-eight (28) years; however, this monitoring schedule may be modified during the Remedial Design phase. Sampling and full-scan (TCL/TAL) analysis of Operable Unit Two ground water monitoring wells would be performed semi-annually for the first five (5) years and then annually for the next twenty-five (25) years. The frequency and character of sampling and analysis may be modified by the USEPA at any time.

A perimeter fence, lockable gates, warning signs and other security measures would be installed around the landfill and the leachate treatment plant.

Water-use restrictions for ground water and surface water would be imposed in the immediate area of the landfill.

Deed restrictions would be imposed to restrict future land-use. The landfill and the immediate area should not be utilized for residential or commercial building.

#### 7.4.4 Major ARARs.

This alternative would comply with the requirements of RCRA Subtitle C for landfill closure. Certain peripheral areas of the landfill would be consolidated into the main part of the landfill. The landfill thermal anomalies would be extinguished by injection of water into subsurface areas. During the landfill consolidation and thermal anomaly extinguishing, measures will be taken to satisfy the requirements in the CAA NAAQS (Section 112) pertaining to fugitive emissions. The landfill electromagnetic anomalies would be excavated and the excavated material sorted, screened, and solidified with Portland cement and redisposed. The treated material would have to satisfy the RCRA LDR requirements for leachability of what are currently unknown contaminants. A variance would be needed if the leachability requirement could not be satisfied; however, the preference for permanent treatment of wastes under CERCLA would be only partially satisfied. The RCRA cap/cover would have a composite hydraulic permeability of at least  $10^{-7}$  cm/sec and would have both an HDPE liner as well as either two feet of compacted clay or a layer of bentonite matting. The cover would be contoured so as to reduce erosion and potential washout damage to the surrounding area. A leachate collection and treatment system would be installed. The treatment system would have both physical and chemical treatment stages, and a biological treatment stage, if it is necessary to reduce concentrations of certain VOCs to very low levels before discharge. The substantive requirements of a KPDES permit would be satisfied. The discharge to the Unnamed Tributary would have to meet the federal or state AWQC, whichever is more stringent, and other standards for surface water.

## 7.5 ALTERNATIVE V - INCINERATION AND STABILIZATION OF LANDFILL ANOMALIES, CONSOLIDATION OF LANDFILL WASTE, LEACHATE COLLECTION AND TREATMENT, CAP AND COVER

### 7.5.1 Treatment Component.

The major landfill electromagnetic anomalies would be excavated, sorted, and screened before being incinerated in an on-Site rotary kiln incinerator to destroy the organics. The treated materials would be solidified with Portland cement to stabilize the inorganics, and then redispersed.

A leachate treatment plant incorporating physical treatment (such as filtration and aeration), chemical treatment (such as the addition of polymers and aluminum sulfate to promote coagulation), and biological treatment systems would be built to the southeast of the landfill. Leachate treatment effluent would be discharged on-site to the Unnamed Tributary. The substantive requirements of a KPDES (NPDES) permit would, nevertheless, be required to be met.

The subsurface thermal anomalies would be extinguished by gas injection. Pressurized nitrogen (N<sub>2</sub>) or carbon dioxide (CO<sub>2</sub>) would be released into the anomalies to displace the subsurface oxygen feeding the thermal anomalies and, thus, stop the combustion.

### 7.5.2 Containment Component.

A leachate collection and treatment system as described above in Section 7.5.1 and in Attachments 7.4 and 7.5 would be constructed to intercept, collect, and contain leachate moving through waste towards the Unnamed Tributary, and other areas downgradient from the landfill (See Figure 9.1.). Sludge from the leachate collection and treatment system would be containerized and properly disposed.

Contiguous Areas A and B (Figure 9.0) would be consolidated within the landfill and the surface of the landfill contoured. The areal extent of contamination in Areas A and B would be determined by a thorough surface and subsurface grid sampling effort during the Remedial Design phase.

A RCRA-type cap and cover with engineered run-on and run-off systems would be constructed over the approximately thirty (30) acre area which constitutes the main landfill.

### 7.5.3 General Components.

Monitoring of the leachate treatment system effluent quality would be performed monthly for the first year after construction is complete, quarterly for the second year, and semi-annually thereafter for the next twenty-eight (28) years; however, this monitoring schedule may be modified with USEPA approval during the Remedial Design phase. Sampling and full-scan (TCL/TAL) analysis of Operable Unit Two ground water monitoring wells would be performed semiannually for the first five (5) years and then annually for the next twenty-five (25) years. The frequency and character of sampling and analysis may be modified by the USEPA at any time.

A perimeter fence, lockable gates, warning signs and other security measures would be installed around the landfill and the leachate treatment plant.

Water-use restrictions for ground water and surface water would be imposed in the immediate area of the landfill.

Deed restrictions would be imposed to restrict future land-use. The landfill and the immediate area should not be utilized for residential or commercial building.

#### 7.5.4 Major ARARs.

This alternative would comply with the requirements of RCRA Subtitle C for landfill closure. Certain peripheral areas of the landfill would be consolidated into the main part of the landfill. The landfill thermal anomalies would be extinguished by injection of nitrogen (N[2]) or carbon dioxide (CO[2]) gas into subsurface areas. During the landfill consolidation and thermal anomaly extinguishing, measures will be taken to satisfy the requirements in the CAA NAAQS (Section 112) pertaining to fugitive emissions. The landfill electromagnetic anomalies would be excavated and the excavated material sorted, screened, and incinerated on-Site to destroy the organics. The treated material would be solidified with Portland cement and redispersed. The treated material would have to satisfy the RCRA LDR requirements for leachability of what are currently unknown contaminants. A variance would be needed if the leachability requirement could not be satisfied. The preference for permanent treatment of wastes under CERCLA would be satisfied. The RCRA cap/cover would have a composite hydraulic permeability of at least 10<sup>-7</sup> cm/sec and would have both an HDPE liner as well as either two feet of compacted clay or a layer of bentonite matting. The cover would be contoured so as to reduce erosion and potential washout damage to the surrounding area. A leachate collection and treatment system would be installed. The treatment system would have both physical and chemical treatment stages, and a biological treatment stage, if it is necessary to reduce concentrations of certain VOCs to very low levels before discharge. The substantive requirements of a KPDES permit would be satisfied. The discharge to the Unnamed Tributary would have to meet the federal or state AWQC, whichever is more stringent, for surface water.

#### 7.6 EXPLANATION OF MAJOR APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) AND TO-BE-CONSIDERED (TBCs) STANDARDS

In this section a general discussion of major applicable or relevant and appropriate requirements (ARARs) and "to-be-considereds" (TBCs) is presented.

Section 121(d) of CERCLA requires that at the completion of remedial action, the Site should achieve a level of control which complies with federal and state environmental laws that are applicable or relevant and appropriate (ARAR) to the hazardous substances, pollutants, or contaminants at the Site. An "applicable" requirement is any cleanup standard, standard of control, or other substantive environmental protection standard promulgated under federal or state law that specifically addresses a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site. To be "applicable", all of the jurisdictional prerequisites of a requirement must be satisfied with respect to the remedial action or site circumstances. A "relevant and appropriate" requirement is any promulgated federal or state environmental law that, while not "applicable" to the hazardous substance, remedial action, or location at a CERCLA site still addresses problems or situations sufficiently similar to those encountered at the Site that its use is well suited to the particular site.

A requirement may be either "applicable" or "relevant and appropriate", but not both. A requirement that is relevant and appropriate must be complied with to the same degree as if it were applicable. However, there is more discretion in this determination. For example, only a part of a requirement may be relevant and appropriate at a site. Only substantive requirements can be ARARs. Administrative requirements cannot be ARARs.

If no ARAR exists for a chemical or the circumstances surrounding the release of a chemical, or if existing ARARs do not ensure protection of human health and the environment, federal and state criteria, advisories, guidance, or proposed rules may be considered. Even if used, however, these "to be considered" (TBC) materials cannot actually be ARARs.

USEPA has established three (3) categories of ARARs:

(1) A chemical-specific ARAR sets health or risk-based concentration limits or ranges in various environmental media for specific hazardous substances, pollutants, or contaminants. Examples of such media are air and water. These ARARs set protective cleanup levels for the contaminants of concern in the designated media or indicate an acceptable level of discharge into a particular medium that occurs during a remedial activity.

(2) An action-specific ARAR is a performance, design, or other similar action-specific requirement that controls particular remedial activities. These requirements are not triggered by the specific chemicals present at a site, but by the particular remedial activities that are selected to accomplish a remedy. These requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved.

(3) A location-specific ARAR sets restrictions on activities, depending on the characteristics of a site or its environs. Location-specific requirements apply to remedial actions evaluated for the site and may be used to restrict or preclude particular remedial alternatives due to the location or characteristics of the Site.

The first step in identifying the ARARs for the site involves identifying the potential chemical-, action-, and location-specific requirements. The second step involves analyzing those requirements to determine whether they are applicable. For a requirement to be applicable, the site circumstances must meet all of the jurisdictional prerequisites of the requirements. Such jurisdictional prerequisites may include:

- . Substance type
- . Site or location type
- . Affected entities
- . Time period
- . Actions involved
- . Other regulatory authorities

If the requirement fails to meet any jurisdictional prerequisite, the requirement is not applicable. The analysis then addresses whether the requirement is relevant and appropriate. The evaluation factors for determining whether a requirement is relevant or appropriate include:

1. Whether the specific objectives of the statute and regulations under which the requirement was created are similar to the specific objectives of the CERCLA action.
2. Whether the media regulated or affected by the requirement are similar to the media contaminated or affected at the CERCLA site.
3. Whether the substances regulated by the requirement are similar to the substances found at the CERCLA site.
4. Whether the entities or interests affected or protected are similar to the entities or interests affected by the CERCLA site.
5. Whether the actions or activities regulated by the requirement are similar to the remedial

action contemplated at the CERCLA site.

6. Whether the type of place regulated is similar to the type of place affected by the CERCLA site or CERCLA action.

7. Whether the type of structure or facility regulated is similar to the type of structure or facility affected by the release or contemplated by the CERCLA action.

8. Whether any consideration of use or potential use of affected resources in the requirement is similar to the use or potential use of the affected resource.

9. Whether the purpose of the requirement in the program of its origin is served by its application at the CERCLA site.

10. Whether any variances, waivers, or exemptions from the requirement are available for the circumstances of the CERCLA site or CERCLA action.

If a regulatory scheme appears to be "relevant and appropriate", each provision in that scheme must be reviewed to determine its relevance and appropriateness for the Site. If an evaluation of a provision against these factors indicates that the Site circumstances are "sufficiently similar" to the problems addressed by the provision, then the provision is relevant and appropriate for evaluating remedial alternatives. Otherwise, it is dropped from consideration.

If an ARAR does not exist or is insufficient to protect human health and the environment, then criteria, guidance, proposed rules, or advisories that are developed or approved by federal or state agencies should be analyzed for their pertinence in establishing a protective remedy. These materials, which are not legally binding, are classified as "to be considered" (TBC) materials.

If a requirement is determined to be an ARAR, it must be complied with unless it meets the CERCLA criteria for a waiver. Under Section 121(d)(4) of CERCLA, USEPA may waive compliance with an ARAR if one of the following six (6) conditions can be demonstrated:

(1) Selection of Interim Remedy - The remedial action selected is only part of a total remedial action that will attain the ARAR level or standard of control when completed.

(2) Greater Risk to Human Health and the Environment Posed Compliance with the ARAR at the site will result in greater risk to human health and the environment than the alternative option chosen.

(3) Technical Impracticability - Compliance with the requirement is technically impracticable from an engineering perspective.

(4) Equivalent Standard of Performance Attained - The remedial action selected will attain a standard of performance that is equivalent to that required by the ARAR through use of another method or approach.

(5) Inconsistent Application of State Requirements - The State has not consistently applied (or demonstrated an intention to apply consistently) the ARAR in similar circumstances at other remedial actions.

(6) Fund Balancing - Attainment of the ARAR would not provide a balance between the need for protection of public health or welfare and the environment at this site and the availability of Fund amounts to respond to other sites that present or may present a threat to the public health

or the environment, taking into consideration the relative immediacy of such threats (for Fund financed cleanups only).

#### 7.6.1 Chemical-specific ARARs.

##### 7.6.1.1 Soil and Sediment

No Federal or State chemical-specific ARAR has been identified for soil and sediments with the possible exception of the levels set under the RCRA Land Disposal Restrictions (LDRs). The LDRs are discussed under action specific ARARs since they are to be applied only if placement occurs and hazardous waste material is land-disposed as a part of the remedy.

##### 7.6.1.2 Water

Federal chemical-specific ARARs have been identified for water. Ground water and surface water, as differentiated from leachate, will not be treated under the selected remedy, unless at a future date USEPA determines that treatment is necessary. However, landfill leachate will be treated and discharged to the on-Site intermittent stream, the Unnamed Tributary, which the Commonwealth of Kentucky considers surface water. The Unnamed Tributary is fed by waters affected by both Operable Units One and Two. The Operable Unit One Remedial Action will ensure that leachate from that area will be collected on-Site before it mixes with stream waters. CERCLA Section 121(e) indicates that a permit is not required for an on-site discharge. However, the substantive requirements of a Kentucky Pollutant Discharge Elimination System (KPDES, NPDES) (401 KAR 5:005) permit are to be satisfied. Background surface water quality sample analyses, federal and state surface water quality criteria (AWQC), and human health risk-based levels will be utilized in the determination of the discharge standards. These standards were developed under the Safe Drinking Water Act (SDWA), and the Clean Water Act (CWA).

Maximum Contaminant Levels (MCLs) are enforceable drinking water standards for public water supplies developed under the SDWA. MCLs apply to specified contaminants which USEPA has determined have an adverse effect on human health above certain levels. These standards must be met by all public drinking water systems. Because these standards are to be met by public water supply systems, they are not directly pertinent to on-Site ground water. However, for ground water that is a potential source of drinking water, MCLs are generally relevant and appropriate standards unless the water is too saline or too contaminated to be used as a drinking water source (53 FR 51441). Because MCLs were promulgated for the protection of drinking water supplies, because the ground water under the Site has been categorized Class III (Subclass B) by the USEPA, because very few local residences utilize water drawn from isolated shallow and deep off-Site systems for household use (with and without treatment), and because ground water from monitoring wells must be compared to a suitable standard, MCLs are not ARARs, but TBCs. In that ground water under and near the landfill does not present a significant exposure problem, no ground water treatment is contemplated.

Water Quality Criteria (WQC) are guidelines developed under the CWA. These Federal criteria are used by states to develop their water quality standards. Different WQC are derived for protection of human health and for protection of aquatic life. The USEPA Water Quality Criteria found in Section 304(a)(1) of the Clean Water Act are relevant and appropriate criteria for the Site. The USEPA criteria for protection of aquatic life from acute or chronic toxic effects or the human health criteria for consumption of fish, whichever is more stringent, is a chemical-specific relevant and appropriate requirement for the surface waters on the Site except where Kentucky Water Quality Standards (WQS) or human health risk-based levels are more stringent.

#### 7.6.1.3 Air

Federal chemical-specific ARARs have been identified for air emissions from the Site. During the extinguishing of the subsurface thermal anomalies and during the consolidation of Areas A and B within the main landfill, air emissions may become a problem. The specific chemical vapors or particulate matter which may present an air emissions problem are not known at this time. Gaseous emissions from uncontrolled hazardous waste sites may be due to the vaporization of liquids, thermal destruction of organics, venting of entrained gases, or chemical and biological reactions with solid and liquid waste material. Methods for controlling the release of gaseous emissions into the atmosphere include the installation of covers, and the use of active gas collection systems, to collect and control gases generated in landfills. Emissions of particulate matter are likely to be caused by incineration or by sources of fugitive dust emissions (Emissions that do not pass through a stack, chimney, vent, or other functionally equivalent opening are "fugitive" emissions.), such as wind erosion of exposed waste materials or cover soil. Commonly used measures for controlling fugitive dust emissions from inactive waste piles and from active cleanup sites, and measures which would be an integral part of the remedy at Operable Unit Two of the Smith's Farm Site, include use of chemical dust suppressants, wind screens, water spraying, and other dust control measures commonly used during construction. The Clean Air Act (CAA) National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) requirements are pertinent to alternatives which require incineration of landfill wastes, which require the excavation of landfill waste which may emit organic vapors, or onsite sources which may combust upon exposure to air and produce harmful smoke and particulates. NAAQS applies to six (6) criteria pollutants: 1) particulate matter equal to or less than ten (10) microns particle size, 2) sulfur dioxide, 3) carbon monoxide, 4) ozone, 5) nitrogen dioxide, and 6) lead. Under Section 107 of the CAA, the Commonwealth of Kentucky has the primary responsibility for assuring that the NAAQS are attained and maintained. Pursuant to Section 112 of the CAA, the USEPA identifies pollutants for which no ambient air quality standard exists, but that cause or contribute to air pollution that may reasonably be anticipated to result in an increase in mortality or in serious irreversible, or incapacitating reversible, illness. The CAA NAAQs are a chemical-specific relevant and appropriate requirement for the Site.

RCRA air emissions regulations for hazardous waste piles, land treatment, and landfills are limited to the requirement that particulate matter from such facilities be controlled by covers or other means. 40 CFR Sections 264.251, 264.273, and 264.301 are relevant and appropriate requirements.

#### 7.6.2 Location-specific ARARs.

Commonwealth location-specific ARARs have been identified for the Smith's Farm Site and are addressed in Section 7.6.4. Federal location-specific ARARs have been identified as follows:

RCRA location requirements mandate that (1) hazardous waste treatment, storage, or disposal facilities located within a one hundred (100) year floodplain must be designed, constructed, operated and maintained to avoid washout (40 CFR 264.18(b)) and (2) hazardous waste treatment, storage, or disposal facilities may not be located within two hundred (200) feet of a significant geological fault (40 CFR 264.18(b)). In general, RCRA authority has been delegated to the Commonwealth of Kentucky. The Site is not located in a floodplain, nor is it located within two hundred (200) feet of a known significant geological fault; therefore, the RCRA location requirements are not ARARs.

Fish and Wildlife Coordination Act (FWCA), 16 USC Section 661 et seq., requires adequate protection of fish and wildlife if any stream or other body of water is modified. The FWCA would be pertinent to alternatives which would consolidate the wastes from Areas A and B within the main landfill because such consolidation would modify or effect at least the west bank of

the Unnamed Tributary. Any alternative requiring remedial action construction could impact the Unnamed Tributary adversely unless precautions are taken to minimize erosion and silting. The Unnamed Tributary (1) is an intermittent stream with rock bottoms and minimal aquatic life, (2) harbors little or no vegetable or humic matter and other sediments, and (3) does not accumulate water in large pools. However, because the lower reaches of the Tributary contain some water most of the year, the FWCA is a relevant and appropriate requirement for the Site.

Endangered Species Act (ESA), Section 7(a), requires that Federal agencies, in consultation with the U.S. Department of the Interior (USDOI) and the National Marine Fisheries Service (NMFS), as appropriate, ensure that the actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their critical habitats. Actions that might jeopardize listed species include direct and indirect effects, as well as the cumulative effects of other actions that are interrelated or interdependent with the proposed action. Substantive compliance with the ESA means that the lead agency must identify whether a threatened or endangered species, or its critical habitat, will be affected by a proposed response action. If so, the agency must avoid the action or take appropriate mitigation measures so that the action does not affect the species or its critical habitat. If, at any point, the conclusion is reached that endangered species are not present or will not be affected, no further action is required.

Two (2) endangered species which may occur near the Site area were identified by the Fish and Wildlife Service of the U.S. Department of the Interior. These species are the Indian bat (*Myotis sodalis*) and the Bald Eagle (*Haliaeetus leucocephalus*). Two (2) species of plants under current status review are the Shepherdsville glade cress (*Leavenworthia exigua*) and *Synandra* (*Synandra hispidula*). The Site is not a critical habitat for these species and the remedy will not significantly affect these species. Therefore, the ESA is not a location-specific ARAR requirement at the Site.

#### 7.6.3 Action-specific ARARs.

Federal regulations that are action-specific ARARs for the Site are discussed below: The Occupational Safety and Health (OSHA) Standards (29 CFR Sections 1910.120, .1000 - .1500, Parts 1926.53, .650 - .653) are not ARARs, because they are incorporated in CERCLA, as amended by SARA. Nevertheless, they will be required to be met because they apply directly by virtue of their own regulatory authority working through CERCLA Section 126. Under the authority of Section 126 of the Superfund Amendments and Reauthorization Act of 1986 (SARA), USEPA and OSHA promulgated identical health and safety standards to protect workers engaged in hazardous waste operations and emergency response. The OSHA regulations, codified at 29 CFR Section 1910.120, became effective on March 6, 1990 (54 FR 9294). The USEPA regulations incorporate the OSHA standards by reference and are codified at 40 CFR Part 311 (54 FR 26654). The OSHA standards (1910.120) for hazardous substance response actions under CERCLA establish the safety and health program requirements that must be implemented in the cleanup phase of a CERCLA response. Under the regulations, a health and safety program will be required for employees and contractors working at the Site. The standards found in 1910.1000 - .1500 govern CERCLA response actions involving any type of hazardous substance that may result in adverse effects on employees' health and safety. These standards also incorporate all of the requirements of 29 CFR Part 1926, the OSHA health and safety standards for construction. The provisions of 29 CFR 1926.650 - .653 are pertinent to any excavation, trenching, and shoring that is undertaken as part of the construction of trenches, cut-off walls, etc.

The Resource Conservation and Recovery Act (RCRA) has action specific provisions which are pertinent to the Site and have been promulgated under 40 CFR Parts 264, 265, and 280. USEPA has determined that the above regulations are relevant to RCRA-characterized or listed hazardous wastes (40 CFR Part 260) if the wastes were disposed at the Site after November 19, 1980, or if

the CERCLA remedial action consists of treatment, storage or disposal (TSD) of hazardous wastes as defined by RCRA (40 CFR Part 264). In addition, these regulations may be relevant and appropriate to remedies involving RCRA hazardous wastes disposed at the Site prior to November 19, 1980, even if those remedies do not involve treatment, storage, or disposal of those wastes (Hazardous wastes were disposed at the Site before November 19, 1980.). Examples of RCRA requirements include minimum technology (MINTECH) standards, treatment standards, monitoring requirements, and storage and disposal prohibitions. For Operable Unit Two, the pertinent portions of RCRA are relevant and appropriate action specific ARARs, because all of the jurisdictional prerequisites of RCRA cannot be satisfied. Although USEPA has delegated the RCRA program to Kentucky, some federal hazardous waste management regulations promulgated under HSWA have not been delegated to Kentucky. For the authorized portions of RCRA, the State requirements are applicable and the corresponding federal RCRA requirements are relevant and appropriate; both are ARARs.

#### 7.6.4 Major State ARARs.

A variety of Kentucky Administrative Regulations (KARs) pertaining to hazardous waste and hazardous substances, air quality, water quality, and transportation are ARARs or TBCs to actions to be taken at the Site.

The following regulations pertaining to hazardous waste and hazardous substances are relevant requirements for the Site, because RCRA hazardous wastes were disposed of in the landfill after November 19, 1980:

- . 401 KAR 34:060, Sections 1,8,9,12 - Groundwater protection

Sections 8 and 9 set forth general ground water monitoring requirements and detection monitoring program requirements which are relevant and appropriate.

- . 401 KAR 34:070 and KAR 47:040 - Closure and post-closure

These sections reflect the RCRA closure requirements. They set out closure performance standards which, among other requirements, are intended to minimize the need for further maintenance and control, minimize or eliminate to the extent necessary post-closure escape of hazardous constituents to ground water or surface water or through the atmosphere, to protect human health and the environment. They provide for the disposal or decontamination of equipment, structures, and soils. They require a survey plat to be submitted to the local zoning authority and the Commonwealth. They provide for postclosure care and use of property. They require a notation on the deed to the property noting the previous management of hazardous wastes thereon and the land use restrictions resulting from that use. These requirements are applicable.

- . 401 KAR 34:190 - Tanks

This part of KAR 34 regulates tank systems that are used for treatment and storage of hazardous waste. This applies to tanks used in the leachate collection and treatment system as well as such tanks as are needed to store water used for decontamination activities. Permits are not required for CERCLA cleanup activities. This KAR is applicable.

- . 401 KAR 34:230, Sections 6,7,8,9 - Landfills

Section 6 provides standards for covers (caps) for sites where waste is left in place. These standards will apply to the design of the final cap at the Site. These requirements contain RCRA standards. They are applicable.

Regulations pertaining to air emissions which will impact remediation:

- . 401 KAR 34:240, 50:025, 51:010, 51:052, 53:010, 63:005, 63:010, 63:020, 63:021 - Air pollution and fugitive emissions control requirements

The fugitive air emissions standards and control measures found in these KARs are applicable to the Site remedial activities because they apply to potential operations such as cap installation, excavation of trenches, and consolidation of landfill wastes, and other activities that may emit dust and other air contaminants. The standards require individuals to take reasonable precautions to prevent particulate matter from becoming airborne when material is handled, or processed, a building is constructed, altered, or demolished, or a road is used. Visible fugitive dust emissions must be contained within the lot line of the property on which the emissions originate. This requirement reflects provisions of the CAA and is an applicable requirement.

Regulations pertaining to water which will impact remediation include:

- . 401 KAR 5:005 - Permits to discharge sewage; industrial and other wastes; definitions

The substantive requirements of this provision are relevant and appropriate requirements which must be met for any discharge. However, no permit is required for on-Site CERCLA activities.

Kentucky's Surface Water Quality Standards, set out in 401 KAR 5:026 - :035, set "minimum criteria applicable to all surface waters". These criteria include specific limits on certain contaminants. In addition, to the extent that the Site contains surface waters as defined by 401 KAR 5:029 Section 1(bb), including intermittent streams with well-defined banks and beds, the surface water standards are applicable chemical-specific standards.

Sections 10 and 11 of 401 KAR 34:060 set forth standards for the compliance monitoring program and corrective action programs which establish how the data gathered will be evaluated and what actions must be taken to eliminate contamination of ground water. Should the ground water monitoring at the Site indicate that the MCLs/MCLGs are consistently exceeded, then an appropriate corrective action will be applied to comply with the MCLs/MCLGs. Sections 10 and 11 would then become applicable.

Regulations which pertain to soil and surface water conservation and will impact remediation include:

- . KRS 262 - Soil and Water Conservation requirements

Chapter 262 of the Kentucky Revised Statutes, which provides for the establishment of soil and water conservation requirements to prevent and control soil erosion, are applicable requirements for this Site. Remedial activities could create changes in soil conditions and surface water flow. The requirements for the technologies/actions that could lead to large scale soil disturbance are applicable.

#### 7.6.5 To-Be-Considereds (TBCs).

Maximum Contaminant Level Goals (MCLGs) are non-enforceable health based goals for drinking water developed under the SDWA. MCLGs are entirely health-based and their attainment assures that even sensitive populations would experience no known or anticipated adverse health effects. Since MCLGs are nonenforceable, chemical-specific goals for drinking water, they are chemical specific TBCs. Under the NCP the USEPA requires that MCLGs set at levels above zero (non-zero MCLGs) be attained during a CERCLA cleanup where they are relevant and appropriate. Where the

MCLG is equal to zero, the USEPA sets the cleanup level to be the corresponding MCL.

Location-specific and action-specific To-Be-Considereds (TBCs) identified for Operable Unit Two of the Smith's Farm Site include well drilling, sealing, and pump installation requirements. Well drilling, sealing, and pump installations will be addressed in the design documents and will be conducted in accordance with the requirements for all actions. The landfill cap and cover system will be designed in accordance with current USEPA guidance on RCRA/CERCLA Final Covers.

The RCRA Land Disposal Restrictions (LDRs) (40 CFR Part 268) were identified as potential ARARs for the Site, because some of the wastes to be managed during the remediation are hazardous wastes; and placement of hazardous wastes is planned for in Alternatives IV and V, and not called for in Alternatives II and III or in the selected remedy. Nevertheless, USEPA has determined that LDR soil cleanup levels set forth in the RCRA LDR regulations (40 CFR 268) are TBCs with respect to the determination of the extent of waste and soils in landfill areas which are to be consolidated within the main landfill area, although risk-based action levels were utilized for consolidation.

The RCRA Proposed Subpart S (55 FR 30798-30884) Corrective Action Levels (RCALs) describe health-based criteria for soil contamination. The exceedance of the criteria indicates that remediation may be required. Because CALs are not promulgated, they are not ARARs, but are TBCs with respect to the delineation of the extent of waste and soils in the contiguous landfill areas which are to be consolidated into the main landfill area.

## **8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES**

### **8.1 THRESHOLD CRITERIA**

#### **8.1.1 Overall Protection of Human Health and the Environment.**

Alternative I is the no-action alternative which would provide inadequate protection of human health and the environment. The formerly permitted landfill would continue to present unacceptable, excessive risks and hazards to the nearby residents.

Alternative II would not provide as much overall protection of human health and the environment as Alternatives III, IV, and V, but more than Alternative I. Unacceptable, excessive risks would remain. The landfill waste would not be consolidated and a cap would not be installed, but a leachate collection and treatment system would be constructed and maintained. The volume of leachate generated would be as large as in the past; a large amount of leachate would be generated after heavy rainfalls because of the lack of a cap and cover system. Therefore, a large capacity leachate treatment plant would be required. The leachate would be treated only by physical treatment processes which would result in the unacceptable discharge of some organic contaminants to the Unnamed Tributary. The landfill's subsurface thermal anomalies would be extinguished by means of excavation, open air burn-out, and a final water spray. A perimeter fence would be built and long-term well monitoring and institutional measures would be undertaken. Without a cap/cover and more complete treatment of collected leachate, the overall protection of human health and the environment would be inadequate since the potential for exposures to the contaminated surface soils, leachate, and leachate sediments would still be significant and unacceptable.

Alternative III would provide an adequate degree of protection for humans and the environment by reducing exposure risks to acceptable levels. Alternative III would (1) subdue the two landfill subsurface thermal anomalies by means of excavation, open air burn-out, and a final extinguishing spray with water or another nonhazardous extinguishing agent, (2) consolidate landfilled materials, and contain the landfill material with a RCRA-type cap/cover system

(thereby reducing leachate generation dramatically), (3) collect and treat any landfill leachate before on-Site discharge to the Unnamed Tributary, and (4) provide institutional controls. After the leachate collection/treatment system and the cap/cover are in place, leachate volume even after heavy rainfalls is expected to be much less than in the past (an estimated reduction of greater than ninety percent [90%]). The exposures to contaminated surface soils, exposed waste, leachate, leachate sediments, and stream sediments would be eliminated through containment measures. Leachate treatment by physical, chemical, and, if necessary, biological or other means, would eliminate the contamination entering the Unnamed Tributary.

Alternative IV provides about the same adequate degree of overall protection for humans and the environment as Alternative III. Alternative IV would subdue the two landfill subsurface thermal anomalies by water injection, consolidate peripheral landfilled materials and contain the landfill material with a RCRA-type cap/cover system (and thereby reduce leachate generation dramatically), collect and treat the landfill leachate before discharging the treated fluids on-Site to the Unnamed Tributary, and provide institutional controls. However, on-Site solidification/stabilization would be used on the waste in the landfill's electromagnetic anomalies in an attempt to stabilize drummed and undrummed hazardous wastes in place and thereby prevent further leaching of both organic and inorganic constituents from those wastes. The landfill's subsurface thermal anomalies would be extinguished by water injection after a leachate collection and treatment system was installed.

Alternative V provides more than adequate overall protection for human health and the environment, but at an excessive cost. All of the landfill's electromagnetic anomalies would be remediated through on-Site incineration and the landfill's subsurface thermal anomalies eliminated by gas (CO<sub>2</sub> or N<sub>2</sub>) injection. Areas of peripheral soil and sediment contamination would be consolidated into the main landfill area. A leachate collection and treatment system would eliminate organics and inorganics from the leachate by physical, chemical, and biological, or other treatment, before on-Site discharge to the Unnamed Tributary. The landfill would be capped, covered, and fenced. Thus, the sources of contamination would be contained and the potential exposures for both humans and the environment would be virtually eliminated. Incineration of wastes from the landfill's electromagnetic anomalies would destroy organic waste constituents, but would leave inorganics to migrate, unless a separate solidification/stabilization treatment phase was implemented.

#### 8.1.2 Compliance With ARARs.

Alternative I, no action, does not comply with ARARs.

In Alternative II leachate treated only by means of physical processes will be discharged to the Unnamed Tributary. ARARs for surface water (Federal and State AWQC) will not be met due to the limited degree of leachate treatment provided. MCLs for ground water would be utilized for TBCs. On-Site monitoring wells would be sampled periodically as in the other four (4) alternatives. Alternative II will not comply with RCRA regulations pertaining to the proper closure of a landfill since there is no engineered cap and cover system to reduce infiltration, percolation, and the generation of leachate. The requirements for NAAQS, State, and local burning ordinances would be observed during the excavation and open air burn-out of the landfill's thermal anomalies; measures designed to reduce fugitive emissions and particulates would be implemented. Peripheral landfill material would not be consolidated as it would be in Alternatives III, IV, and V.

Alternative III will comply with surface water ARARs (Federal and State AWQC) if biological treatment is utilized in conjunction with the physical and chemical treatment of leachate (See Section 9.0.1.). MCLs for ground water would be utilized as TBCs. On-Site monitoring wells would be sampled periodically. Treatment of ground water is neither expected nor predicted due

to the low permeability and isolating character of the shale geology underlying the landfill. Alternative III will comply with RCRA (and KAR) regulations pertaining to the proper closure of a landfill since there is an engineered cap and cover system to reduce infiltration, percolation, and the generation of leachate. It appears that ARARs do not exist for the remediation of the landfill's thermal anomalies. The requirements for NAAQS, State, and local burning ordinances would need to be observed during excavation; measures designed to reduce fugitive emissions and particulates would be implemented not only during the extinguishing of the subsurface thermal anomalies, but also during the consolidation of peripheral landfill material into the main landfill area as in Alternatives IV and V. All other ARARs would be complied with.

Alternative IV will comply with ARARs for surface water (Federal and State AWQC). MCLs for ground water would be utilized as TBCs. On-Site monitoring wells would be sampled periodically. Treatment of ground water is neither expected nor predicted due to the low permeability and isolating character of the shale geology. Solidification of the landfill's electromagnetic anomalies would comply with RCRA LDR requirements with regard to the leachability of the stabilized/solidified wastes; administrative variances may be necessary due to the technical impracticability of treating heterogeneous wastes to the low specific-constituent cleanup levels required under LDRs. It does not appear that there are ARARs specific to remediation of the landfill's subsurface thermal anomalies. However, the NAAQS, State, and local burning ordinances would be substantively adhered to; measures designed to reduce fugitive emissions and particulates would be implemented. Peripheral landfill material would be consolidated as in Alternatives III and V; therefore, the fugitive emissions and particulates associated with the consolidation of landfill wastes would have to be dealt with during construction. Alternative IV will comply with RCRA regulations pertaining to the proper closure of a landfill since there is an engineered cap and cover system to reduce infiltration, percolation, and the generation of leachate.

Alternative V will comply with all ARARs. It will meet surface water ARARs (Federal and State AWQC) via the leachate collection and treatment system. Leachate migration to the Unnamed Tributary would stop due to the installation and operation of a leachate collection and treatment system. MCLs for ground water would be utilized as TBCs. On-Site monitoring wells would be sampled periodically. Incinerated contaminated material from the landfill's electromagnetic anomalies would be treated in compliance with CAA and RCRA ARARs pertaining to air quality and the operation of hazardous waste incinerators. The material resulting from incineration would probably not satisfy LDR leachability standards for inorganic constituents; thus, variances may be needed to allow redisposal, or the material may need to be stabilized/solidified. It appears that ARARs specifically for the remediation of the landfill's subsurface thermal anomalies do not exist; however, the substantive requirements of the NAAQS, State, and local burning ordinances would be met; measures designed to reduce fugitive emissions and particulates would be implemented. Peripheral landfill material would be consolidated as in Alternatives III and IV; therefore, the fugitive emissions and particulates associated with the consolidation of peripheral landfill wastes would have to be managed during construction. Alternative V will comply with RCRA regulations pertaining to the proper closure of a landfill since there is an engineered cap and cover system to reduce infiltration, percolation, and the generation of leachate, and a leachate containment and treatment system.

## 8.2 PRIMARY BALANCING CRITERIA

### 8.2.1 Long-Term Effectiveness and Permanence.

Alternative I is the no-action alternative. This alternative reflects the current situation with regard to the protection of human health and the environment. The alternative is not an effective remedy and, therefore, does not provide the necessary long-term effectiveness, protectiveness, and permanence.

Alternative II does not require treatment of the landfill electromagnetic anomalies and does not incorporate the consolidation and capping of the landfill waste. The landfill thermal anomalies would be extinguished by excavation and open air burn-out. Leachate is collected and treated using only physical treatment, but no chemical or biological treatment stages. Institutional and security measures would be undertaken. This alternative does not provide as effective, permanent, and reliable protection of human health and the environment as do Alternatives III, IV, and V. Without a cap and cover (as in Alternatives III, IV, and V), rainfall will infiltrate through the landfill waste and flush out waste constituents which will appear in the leachate. The quantity of leachate generated will be proportional to the amount of rainfall; a large treatment system will be required to handle the large quantity of leachate generated during high rainfall events, and there will still be an unacceptable discharge of organic contaminants to the Unnamed Tributary. Thus, the long-term effectiveness of the Alternative II remedy is not acceptable; there is no comprehensive, permanently effective remediation as there is in Alternatives III, IV, and V.

Alternative III does not treat the landfill's electromagnetic anomalies, but does extinguish the subsurface thermal anomalies by means of excavation, airing, and spraying with water. After peripheral landfill areas are consolidated, the landfill will be capped and covered. The leachate would be collected and treated physically, chemically, and, if necessary, biologically or by other processes, to remove both organics and inorganics from the leachate before discharging the treated fluids. Institutional and security measures would be as in Alternatives II, IV, and V. The long-term effectiveness, permanence, and expected reduction in residual risk are acceptable and reflect a more reliable and permanent level of protection of human health and the environment than Alternatives I and II, and a level of long-term effectiveness on par with Alternatives IV and V.

Alternative IV provides long-term effectiveness and permanence in much the same fashion as Alternative III above. However, the landfill's excavated electromagnetic anomalies would be treated on-site by stabilization with cement or pozzolanic additives; and the landfill's subsurface thermal anomalies would be extinguished by water injection. The long-term prognosis for contaminant migration and transmission would be approximately the same as for Alternative III in that leachate generation would be dramatically reduced, and leachate treatment would eliminate the migration of untreated leachate to the Unnamed Tributary. The stabilization of the landfill's electromagnetic anomalies would greatly retard the leaching of a portion of the landfilled drummed and undrummed wastes, but, in the long-term, both the treated and untreated landfill wastes would still generate a quantity of leachate relative to the actual effectiveness of the cap and cover system.

Alternative V would do the most towards the reduction of expected residual risk, but at excessive cost. Outlying or peripheral areas of contamination would be consolidated for capping. The permanent cap and cover would virtually eliminate the risk of soil ingestion and dermal contact and would effect a drastic reduction in the volume of leachate generated. Prior to capping, the landfill's thermal anomalies would be excavated and incinerated on-site, thus removing the organics from the waste. The subsurface thermal anomalies would be extinguished by gas (CO<sub>2</sub> or N<sub>2</sub>) injection. The virtual elimination of leachate seepage into the Unnamed Tributary, and elsewhere, would reduce the amounts of contaminated fluids affecting the on-Site intermittent streams and their sediments. The cap and cover would reduce the amount of rainfall infiltration. The small amount of leachate generated by the landfill would be captured by the leachate collection system and treated by a multi-stage leachate treatment system which would treat the leachate physically, chemically, and biologically, or by other processes, to approved standards before on-Site discharge of the clean effluent to the Unnamed Tributary. The landfill and the leachate treatment system would be fenced, signed, and inspected regularly. With proper operation and maintenance, the cap, leachate collection and treatment system, and security measures would constitute a permanent remediation and would continue to be effective well into the future, but at excessive cost relative to Alternatives III and IV.

#### 8.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment.

Alternative I is the no-action alternative. No cap or cover would be installed. And, except for the installation of a fence and continued monitoring, the landfill would be as it was as of the completion of this Record of Decision. There would be no reduction of toxicity, mobility, or volume through treatment.

Alternative II requires the extinguishing of the landfill's subsurface thermal anomalies by means of excavation, airing, and spraying with water. This process may generate smoke, fugitive emissions, and various particulates which would be managed according to NAAQS, State, and local requirements. No cap or cover would be installed; therefore, the fluctuations in the volume of leachate generated would be the same as in Alternative I. This alternative requires the installation of a leachate collection and treatment system similar to that in Alternatives III, IV, and V, but only physical treatment processes would be used for leachate treatment. Thus, some organic contaminants would not be removed from the leachate before discharge, which may be construed as a partial reduction of total original toxicity, mobility, and volume. The landfill's electromagnetic anomalies would not be addressed and would, therefore, not be subjected to a reduction of toxicity, mobility, or volume.

Alternative III reduces the generation of leachate by installation of a cap and cover. Any leachate generated after the installation of the cap and cover will be collected and treated by physical, chemical, and, if necessary, biological or other processes, and the treated effluent discharged to the Unnamed Tributary. The landfill's subsurface thermal anomalies would be extinguished by excavation, airing, and spraying with water. Alternative III does not attempt to treat the landfill's electromagnetic anomalies, but relies on the cap and cover to reduce rainfall infiltration and thus lessen leachate volume such that the smaller amount of leachate generated can be readily collected and treated by standard physical, chemical, and, if necessary, biological or other treatment processes. The cap and cover would reduce the amount of leachate generated by more than ninety percent (90%). The toxicity, mobility, and volume of leachate would be reduced. The mobility of the landfilled waste contaminants would be reduced, but the toxicity and volume of the source waste materials would not be decreased.

Alternative IV extinguishes the subsurface thermal anomalies by means of water injection which will, in the short-term, generate leachate which will have to be collected and treated before discharge. Thus, a leachate collection and treatment system will have to be in place prior to the work on the landfill's subsurface thermal anomalies. The landfill's electromagnetic anomalies would be stabilized with cement or pozzolanic additives which would reduce the toxicity, mobility, and, to an unknown degree, the volume of hazardous substances available for leachate generation. With the cap and cover installed and the leachate collection and treatment systems operating, the Alternative IV remedy should reduce the overall toxicity and mobility of the hazardous components of the waste. The volume of hazardous substances available for exposure to humans and the environment would be lessened by solidification/stabilization of the landfill's electromagnetic anomalies and by the multi-stage treatment of leachate. The cap and cover would reduce the amount of leachate generated by more than ninety percent (90%).

Alternative V reduces the toxicity of the landfill waste in the electromagnetic anomalies by subjecting the excavated waste from the anomalies to on-site incineration (which is a very expensive treatment process), thus removing the organics from the waste. However, inorganics would remain a problem unless they were immobilized by solidification/stabilization before redispersion into the landfill. The landfill's subsurface thermal anomalies would be extinguished by means of gas (CO<sub>2</sub> or N<sub>2</sub>) injection, which would not generate any leachate, unlike the procedures used in Alternatives III and IV. The cap and cover would reduce the amount of leachate generated by more than ninety percent (90%). Waste toxicity, mobility, and volume would be reduced as aforementioned.

### 8.2.3 Short-Term Effectiveness.

Alternative I, the no-action alternative, has already achieved its optimal short-term effectiveness.

Alternative II would begin to be effective when the leachate collection and treatment systems were operating. Without a cap, however, the amount of leachate generated would continue to fluctuate widely; and with a treatment system relying only on physical processes for leachate treatment, the fluid entering the Unnamed Tributary will probably exhibit approximately the same characteristics as it has in the past.

Alternative III would begin to have a significant amount of effectiveness after the bentonite matting layer had been installed on the landfill subsequent to the subsurface thermal anomalies having been remediated. Rainfall infiltration and, consequently, leachate production would be reduced. Optimal shortterm effectiveness would begin to occur when the cap and the leachate collection and treatment systems were completely in place as in Alternatives IV and V. Temporary check dams and erosion control measures along the Unnamed Tributary would minimize contaminant transmission.

Alternative IV would begin to have significant short-term effectiveness once the solidification of the landfill waste in the electromagnetic anomalies was completed, the thermal anomalies were remediated, and the bentonite matting layer of the cap was installed. Optimal effectiveness would not occur until the the completed cap and leachate collection and treatment systems were in place and the leachate treatment plant was fully functional as in Alternatives III and V.

Alternative V would begin to have significant short-term effectiveness once the incineration of the landfill electromagnetic anomalies was completed, the thermal anomalies were remediated, and the bentonite matting layer of the cap was installed. Further gains in effectiveness would occur with the completion of the cap and cover system and the full functioning of the leachate treatment plant as in Alternatives III and IV.

### 8.2.4 Implementability.

Alternative I is implementable in that no major work must be done to satisfy its requirements.

Alternative II is very implementable. The landfill's electromagnetic anomalies would not be remediated. The subsurface thermal anomalies would be extinguished by excavation and airing, although as in Alternative III below, water may be sprayed on the smoldering material to smother the combustion. Once the subsurface thermal problem is remediated, the landfill surface can be recontoured; the construction of the leachate collection and treatment system can proceed concurrently. Alternative III is somewhat more complicated to implement than Alternative II. The landfill surface cannot be recontoured until the subsurface thermal anomalies are extinguished. The smoldering material would be excavated and allowed to burn out. Water may be sprayed on the burning material in order to cool it, to dissipate the built-up heat, and to smother the combustion. However, a leachate collection and treatment system may not have to be in place and operating early in the construction. Temporary earthen berms, silt fences, and check dams would mitigate the surface run-off. Once the landfill surface is recontoured, the leachate collection and treatment systems as well as the cap and cover would be installed in the same way as in Alternatives IV and V.

Alternative IV is the second most complicated alternative to implement. The landfill surface cannot be recontoured until the landfill's electromagnetic and thermal anomalies are dealt with. However, the anomalous wastes would be subjected to solidification/stabilization which would have fewer administrative problems than incineration. The extinguishing of the subsurface

thermal anomalies by means of water injection would require that at least a rudimentary leachate collection and treatment system be in place and operating or that other capture devices be installed into the landfill downgradient from the subsurface thermal anomalies to collect and treat (and possibly reuse) the injected water.

Alternative V is the most complicated alternative to implement. The landfill surface cannot be recontoured until the subsurface thermal anomalies are extinguished and the landfill electromagnetic anomalies are excavated and incinerated on-site. Companies offering incineration technologies do not supply their services on demand, but require substantial lead times. Additionally, treatability studies, mobilization, test burns, material sorting, mechanical breakdowns, weather delays, and demobilization expend large amounts of time and money. While the remedy is technically feasible, it is administratively complex. The services of many different subcontractors would be utilized. The timing and movement of the subcontractors would have to be choreographed and adjustments made as problems are encountered. The extinguishing of the subsurface thermal anomalies by means of gas (CO[2] or N[2]) injection may not work as advertised; therefore, it may take longer to extinguish the thermal anomaly than was originally anticipated.

#### 8.2.5 Cost.

Alternative I has an estimated Present Worth Cost between zero and \$2,191,000, depending upon how many institutional actions are undertaken.

Alternative II has an estimated Present Worth Cost of \$3,279,000.

Alternative III has an estimated Present Worth Cost of \$38,975,000.

Alternative IV is the next most costly remedy. It has an estimated Present Worth Cost of \$66,883,000.

Alternative V is the most costly alternative of the five (5) alternatives presented. Its estimated Present Worth Cost is \$115,027,000.

Estimated Present Worth Costs reflected above are broken down into Capital Costs and Thirty (30) Year O & M Costs in Table 8.0.

**TABLE 8.0 : DESCRIPTION OF FIVE ALTERNATIVES**

	DESCRIPTION	TOTAL PWC	CAP COST	30-YR. O&M
COST				
1	No Action or Limited Action	\$0 to \$2,191,000	\$133,000	\$2,058,000
	Limited Institutional Action, Collection and Treatment of			
2	Leachate Using Physical Treatment, Extinguish Landfill Fire By Excavation	\$3,279,000	\$928,000	\$2,351,000
	Limited Institutional Action, Excavate Areas of Outlying Soil Contamination and Cap Formerly			
3	Permitted Landfill, Collection of Leachate and Chemical/Physical Treatment for Heavy Metal and Organic Removal, Extinguish Landfill Fire by Excavation	\$38,975,000	\$34,579,000	\$4,378,000
	Limited Institutional Action, Excavate Areas of Outlying Soil Contamination and Cap Formerly Permitted Landfill, Excavate Hot			
4	Spots and Treat Using On-site Stabilization, Collection of Leachate and Chemical/Physical Treatment for Heavy Metal and Organic Removal, Extinguish Landfill Fire By Water Injection	\$66,883,000	\$62,505,000	\$4,378,000
	Limited Institutional Action, Excavate Areas of Outlying Soil Contamination and Cap Formerly Permitted Landfill, Excavate Hot Spots and Treat Using On-site			
5	Incineration, Collection of Leachate and Chemical/Physical/ Biological Treatment for Heavy Metal and Organic Removal, Extinguish Landfill Fire By Gas Injection	\$115,027,000	\$109,175,000	\$5,852,000

### 8.3 MODIFYING CRITERIA

#### 8.3.1 State/Support Agency Acceptance.

The Commonwealth of Kentucky did not concur with the Operable Unit One Record of Decision which was completed in September 1989. Kentucky offered only a partial concurrence on the Amendment to the Operable Unit One Record of Decision, which was finalized in September 1991. The Commonwealth gave partial concurrence to the Operable Unit Two proposed plan remedy in that it concurred with the installation of the RCRA-type cap and cover system and with the implementation of the leachate collection and treatment system design, but wanted the landfill anomalies to be treated by solidification. The Commonwealth has since concurred with the Operable Unit Two selected remedy.

#### 8.3.2 Community Acceptance.

In the past the community has not been overly aggressive about being involved with activities at Smith's Farm, although public meetings have always been well-attended. Bullitt County government officials (i.e., the Health Department, the County Magistrate, and a County Judge) have maintained contact with USEPA Region IV and have attended all of the public meetings. The Responsiveness Summaries for the ROD and the ROD Amendment for Operable Unit One indicate that the community was not in favor of on-site incineration as well as the hauling of hazardous materials over County roads. Additionally, residents of the mobile home park immediately south of the landfill have been quite vocal about the need to extend public water lines to all residences in and around the mobile home park. Because of the thin overburden in the area of the mobile home park, the continued use of cisterns and septic tanks by several households in the area, and the existence of a common above-ground sewage lagoon in the mobile home park, the use of stream water for drinking/bathing and the use of shallow wells is not recommended from a public health standpoint. The community appears to understand that, at the present time, the runoff from the landfill does not have a significant environmental impact on the Unnamed Tributary and the mobile home park, and that problems with unpotable ground water and surface water generally derive from population density, the lack of competent water and sewage treatment facilities for some households, and the naturally poor quality of ground water and surface water in the area.

### 9.0 THE SELECTED REMEDY

The selected remedy is a modified Alternative III which includes (1) the extinguishing of the subsurface landfill thermal anomalies, (2) the consolidation within the landfill of peripheral, contiguous areas of landfill material, (3) the installation of a leachate collection system at the bedrock surface along the entire east and southern sides of the landfill, which diverts leachate to a collection tank and to a multi-stage treatment system which then discharges treated, cleaned liquid to the Unnamed Tributary, (4) the installation of a multi-layer RCRA-type cap and cover system with attendant run-on and run-off systems, and (5) the installation of perimeter fencing, lockable gates, warning signs, and the imposition of deed restrictions and water use restrictions.

#### 9.0.1 Treatment Component.

Subject collected leachate to both physical and chemical treatment and, if necessary, biological or other treatment process(es), and discharge on-Site to the Unnamed Tributary. The discharge shall meet the substantive requirements of a KPDES (NPDES) discharge.

Excavate thermal anomalies and spray with water or fire retardant chemical foam or apply other appropriate nonhazardous substances until the combustion has been extinguished.

#### 9.0.2 Containment Component.

Excavate contaminated soil and waste from Areas A and B and other contiguous contaminated areas (e.g., sediments from the Unnamed Tributary) immediately proximal to the formerly permitted landfill and consolidate them within the main landfill area (See Figure 9.0.). The extent of contamination in contiguous Areas A and B (and other contiguous areas) shall be determined by surface and subsurface grid sampling, and by best engineering judgement, during the Remedial Design phase (See Section 9.1.5.).

Drums and other waste uncovered during excavation shall be handled with best management practices and consolidated within the main landfill. Since consolidation will take place within the same area of contamination (AOC), such consolidation will not constitute placement of wastes under RCRA and will not, therefore, trigger RCRA Landban Restrictions (40 CFR Part 268). Construct a leachate collection system to intercept and collect leachate moving through waste and fill material towards the Unnamed Tributary and other areas downgradient from the landfill (See Figure 9.1.).

Contour/terrace the surface of the landfill and install the cap and cover. The RCRA-type cap shall include a synthetic membrane of at least forty (40) mil thickness and may substitute bentonite matting for the two (2) foot thick clay layer, and may substitute geotextile materials for the drainage layer(s). Permanent engineered run-on and run-off systems shall be constructed as a part of the cap/cover system. The run-on and run-off controls shall be designed for at least a fifty (50) year rainfall event with a factor of safety of at least one-and-one-half (1.5). During the Remedial Action construction, temporary run-on/run-off and erosion/silt control systems shall be in place.

#### 9.0.3 General Components.

Investigate and better delineate the metallic anomalies, i.e., smaller dump sites, along the Unnamed Tributary from the Operable Unit Two area, the formerly permitted landfill, to beyond the area addressed by the Operable Unit One activities. Excavate and dispose of surficial metallic and nonmetallic anomalous materials in either the Operable Unit One or the Operable Unit Two landfill (See Section 9.1.5.).

Expand the existing ecological survey to include bioassays of biota living in the Unnamed Tributary. More thoroughly investigate the landfill's affects on flora and fauna and, especially, threatened and endangered species.

Install a perimeter fence, lockable gates, warning signs, and other security measures.

Perform sampling and full-scan (TCL/TAL) analysis of Operable Unit Two ground water monitoring wells and certain surface waters semi-annually for the first five (5) years after landfill closure and then annually for the next twenty-five (25) years. The frequency and character of sampling and analysis of the leachate effluent will be determined during the Remedial Design phase and may be modified by USEPA and the Commonwealth of Kentucky at any time.

Impose water use restrictions for ground water and surface water in the immediate area of the landfill. These waters shall not be used for potable water sources as a precaution against possible future releases of contaminants.

Impose deed restrictions to restrict future land-use. The landfill and the immediate area around the landfill shall not be utilized for residential or commercial building due to the continued presence of hazardous contaminants on-Site and the probable settling and subsidence of the landfill.

## 9.1 REMEDIATION LEVELS AND OBJECTIVES

The purpose of this remediation activity is to reduce present risks posed by direct contact with landfill contaminated soils/sediments/leachate, to reduce the need for long-term management, significantly reduce the toxicity, mobility and volume of waste both long-term and short-term, and during remediation. There are two media with their two associated remediation activities which need remediation levels to define either the extent of the contamination or the quality of the treatment process(es). The two media are (1) waste and fill/soils/leachate sediments, and (2) leachate water/very shallow ground water. Waste and fill/soils/leachate sediments will be excavated/moved to other parts of the landfill in order to consolidate material and contour the surface of the landfill.

Very shallow ground water derived directly from rainfall flows vertically and horizontally through the landfill and overburden, generating and carrying leachate, and then along the overburden/rock interface, and emerges as seeping/flowing leachate. Leachate flows into the Unnamed Tributary where it may be ingested as drinking water by residents. Leachate liquid is to be collected, treated, and the cleaned liquid discharged on-Site to the Unnamed Tributary.

### 9.1.1 Buried Waste and Fill Material.

The formerly permitted landfill contains a variety of industrial wastes, including an unknown number of buried drums which may contain hazardous substances. The wastes and drums in the formerly permitted landfill are mixed with trash, construction debris, and other fill material. The remediation objective for the landfill waste and fill material is to control the migration of contaminants from the waste and fill material to the surrounding media by consolidation and containment of the landfill material.

When consolidating the waste, fill material, soils, and leachate sediments from the east side of the landfill near the Unnamed Tributary and from Area B on the southwest side, excavation to the bedrock may be required. During the Remedial Design process, the areal limits of the excavation shall be determined by the results of additional grid sampling all along the east, southeast, and southwest sides of the landfill, as well as by best engineering judgement, except as described in Section 9.1.5. Since the areas to be excavated and consolidated within the main body of the landfill are contiguous areas of the landfill, LDR requirements relating to placement do not apply. Sediments in the bed of the Unnamed Tributary and soils east of the Unnamed Tributary shall not be consolidated into the main landfill without prior approval by the USEPA.

The remediation levels for organic contaminants of concern for surface soils and leachate sediments, which will be utilized for the consolidation of peripheral landfill areas, are set forth in Tables 9.0a and 9.0b. The remediation levels in Tables 9.0a and 9.0b are to be utilized only to delineate the areal extent of the material to be consolidated. If additional contaminants are discovered during the remedial design, or the remedial action, which warrant the calculation of additional soil remediation levels, USEPA will establish these new levels using a similar approach to that utilized in the calculations for the remediation levels set forth in Tables 9.0a and 9.0b.

The Table 9.0a Remediation Levels for consolidation of surface soils and leachate sediments were determined by back-calculating from an individual constituent carcinogenic risk of  $1 \times 10^{-6}$  and an individual constituent noncarcinogenic risk of  $HQ = 0.1$  (for an adult or a child, whichever was appropriate) utilizing standard risk assessment equations which may be found in Section 3 of the Operable Unit Two Risk Assessment. If the calculated Remediation Level (or Exposure Point Concentration) could not be accommodated by USEPA Region IV Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual (ECBSOPQAM)

Contract Required Quantitation Limits (CRQL), then a slightly higher risk was utilized and another Remediation Level calculated. This process was repeated until the Remediation Level could be accommodated by the CRQL. For further explanation of the manner of determination of the Remediation Levels, see Attachment 9.0.

Table 9.0b sets forth a decision mechanism for determining peripheral areas to be consolidated. Alternatively, all of the soils and leachate sediments in the peripheral areas roughly delineated in Figure 9.0 may be excavated to the bedrock and consolidated in the main landfill area.

#### 9.1.2 Leachate and Very Shallow Ground Water.

The remediation objective for the leachate is to prevent or minimize leachate generation and subsequent leachate migration into the surrounding media.

Hazardous constituents have been detected in the leachate which collects and flows in the formerly permitted landfill and in the soils between the landfill and the Unnamed Tributary. Rain water infiltrates through landfilled waste generating leachate which migrates along the soil/bedrock interface and discharges through seeps or visible leachate outbreaks along the soil/bedrock interface exposed along and near the western bank of the Unnamed Tributary.

If the landfill wastes and fill material are successfully contained for the long-term, rainfall infiltration into the landfill will be minimized, and the production of leachate will likewise be reduced or eliminated. Even after containment measures are implemented, some leachate may continue to emanate from the landfill as a result of (1) liquids which remain contained within the waste material after capping, (2) a small amount of rainfall infiltration, and (3) natural changes in subsurface temperature and pressure. The remediation objective for this continued leaching is to prevent the infiltration of rain water and migration of any resulting leachate beyond the boundary of the containment area by capping the landfill and by intercepting, collecting, and treating the leachate.

The area or very shallow plume of leachate perched or flowing on the bedrock under and around the pump house, and under the unimproved road next to the pump house, in the southeast quadrant of the landfill, will be intercepted by the leachate collection system.

It is necessary to treat the collected leachate to at least the surface water quality criteria (Kentucky Warm Water Aquatic Habitat Criteria and the Federal Ambient Water Quality Criteria for the Protection of Aquatic Life, and other standards) which protect the public health, the public welfare, and the environment and which allow an on-Site discharge to the Unnamed Tributary. In accordance with Section 121(e) of CERCLA, a permit is not needed for the on-Site discharge of treated leachate to the Unnamed Tributary. However, the discharge shall comply with all substantive requirements of the KPDES (NPDES). Exact discharge criteria will be established during the Remedial Design phase. However, Table 9.0c describes the human health risk remediation levels for treated leachate water which shall be considered when determining the exact discharge criteria.

#### 9.1.3 Surface Water and Surface Water Sediments.

Hazardous constituents detected in the intermittent Unnamed Tributary result primarily from leachate seepage into the Tributary as described in Section 9.1.2 above; however, the Tributary may also be impacted by surface runoff from the landfill. Some leachate will continue to be generated, but will be contained by the collection system; the primary source of contamination of the Tributary will be eliminated. When the landfill surface is covered by an impermeable barrier, then contact between surface run-on/runoff and the landfill waste, the secondary source

of contaminated water, will be eliminated. Remediation of Unnamed Tributary surface waters and sediments is not currently considered necessary since (1) average contaminant levels in the Unnamed Tributary and in its sediments (near the formerly permitted landfill) are at acceptable levels and (2) planned remediation activities are directed at eliminating the possibility of further contamination of surface waters and surface water sediments.

#### 9.1.4 Landfill Thermal Anomalies.

Two underground thermal anomalies have been detected in the northeast and northwest portions of the landfill. The source of these anomalies appears to be two subterranean fires of buried, smoldering wood. Although the thermal anomalies appear not to represent any danger, they will be further investigated and extinguished as a part of the remedial action at the landfill.

There are no apparent air quality standards associated with open air burning or smoldering of wood, and other materials, which may or may not be contaminated with hazardous substances. However, the local fire department shall be consulted and air quality monitoring for this specific remediation activity shall be maintained until the fire(s) are extinguished. A written record of the air monitoring effort shall be made part of the Remedial Action Report.

#### 9.1.5 Metal Anomalies Near the Unnamed Tributary.

Surficial metal anomalies lying along the Unnamed Tributary between the Operable Unit Two and Operable Unit One areas, and identified during the Operable Unit Two Remedial Investigation, shall be excavated and disposed, using best management techniques, into either the Operable Unit One or the Operable Unit Two landfill based upon several factors, including (1) the schedule for the construction of the Operable Unit One and Two landfills, (2) the volume of material to be disposed, and (3) the distance of the particular anomaly from an Operable Unit landfill.

Nonmetallic trash, such as old vehicle tires and vehicle seat covers, shall be disposed utilizing best management practices.

### 9.2 STATUTORY DETERMINATIONS

#### 9.2.1. Protection of Human Health and the Environment.

The selected remedy will eliminate, reduce, or control risks posed through each pathway by means of treatment and implementation of engineering and institutional controls and thus ensure adequate protection of human health and the environment. Potential risks posed by Operable Unit Two through each of the following pathways will be either eliminated, reduced, or controlled by the response action.

Although the surface waters of the Unnamed Tributary have not been demonstrated to have been significantly contaminated, several leachate seeps along the east side of the landfill flow into the Unnamed Tributary. Additionally, surface run-off from the existing landfill cover flows into the Unnamed Tributary. The installation of a RCRA-type landfill cap will minimize the amount of leachate generated and will place a barrier between the contaminated landfill soils and the top of the landfill such that surface run-off will not be contaminated by "dirty" surface soils. The installation of the leachate collection and treatment system will further isolate the reduced amount of landfill leachate and will treat the leachate, and discharge the treated, cleaned liquid to the Unnamed Tributary.

The small ponds to the southwest of the landfill that catch some landfill surface run-off will benefit from the installation of a proper cap and cover and the accompanying run-on/run-off diversion structures which are expected to divert surface run-off to armored outfalls on the

banks of the Unnamed Tributary.

Thus, the surface water, leachate seeps, and surface soil pathways will be eliminated or controlled by the remedy.

Buried waste and subsurface soils will be contained by the RCRA type cap and the compact shale rock under the landfill. A leachate plume has been determined to be a problem only in the southeast quadrant of the landfill. The leachate collection and treatment system should control the described leachate problem.

USEPA has determined that there is not a current air contamination problem. However, during the remedial design further air monitoring will be accomplished; and during the remedial action on-site air monitoring will be an integral part of the Health and Safety Plan and of field operations.

The remedy is protective of the environment because the cap and the leachate collection and treatment system significantly decrease flora and fauna contamination; and the leachate treatment system reduces the potential for significant contamination of the Unnamed Tributary and the piscatory and benthic species therein.

Site future risks will be reduced to within the 10<sup>-6</sup> to 10<sup>-4</sup> range for carcinogens and the Hazard Indices total for non-carcinogens will be less than 1.0.

No unacceptable short-term risks or cross-media impacts will be created by implementation of the remedy.

#### 9.2.2 Compliance With Applicable or Relevant and Appropriate Requirements (ARARs).

The selected alternative consists of closure of the formerly permitted Smith's landfill in accordance with KDNREPC and RCRA regulations governing hazardous waste landfill closures, along with a sampling program to monitor changes in ground water, surface water, and the effectiveness of leachate treatment. Alternative III is designed to meet the applicable or relevant and appropriate requirements (ARARs). The Federal ARARs include the Resource Conservation and Recovery Act (RCRA) (42 USCA Section 6901 et seq and 40 CFR Part 264) and the Clean Air Act (42 USCA 7401 et seq and 40 CFR Part 50 and 61). State ARARs include: 601 KAR 1:025 -- Transportation of Hazardous Materials and KRS 174.415 -- Hazardous Materials, Permits, Emergency Procedures, Enforcement; 401 KAR 34:240, 50:025, 51:010, 51:052, 53:010, 63:010, 63:020, 63:021, and 63:005 pertaining to air pollution and fugitive emissions control requirements; and 401 KAR 34:070, and 47:040 pertaining to deed notices on solid or hazardous waste sites. For further discussion of Site ARARs, see Sections 7.6, 8.1.2, Table 9.1, and Sections 9.2.2.1 through 9.2.2.3.

##### 9.2.2.1 Resource Conservation and Recovery Act (RCRA)

Because some disposal of hazardous waste at the Smith's landfill occurred after the effective date of the RCRA regulation (November 19, 1980) the requirements of RCRA Subtitle C regulations which are triggered by the selected remedy are applicable and must be met. Section 264.310 of RCRA Subpart N specifies the performance-based requirements for a cover at completion of landfill construction. The cover system for the landfill will be a cap and cover system as described in RCRA guidance and will comply with the relevant and appropriate RCRA regulations. The cap will minimize migration of liquid through the landfill, function with minimum maintenance, promote surface drainage, minimize erosion, minimize leachate generation, accommodate settling, and be less than the permeability of natural subsoils present.

After construction is completed, the substantive monitoring and maintenance requirements contained in Section 264.117 through 264.120 of Subpart G will be conducted. The landfill will be capped according to the standards in Subpart G Section 264.111 - Closure Performance Standards. After the closure activities have concluded, a survey plat, as prescribed in Subpart G Section 264.116, indicating the location and dimensions of the disposal area will be submitted to the local zoning authority, or to the authority with jurisdiction over local land use, and the USEPA Region IV Regional Administrator as well as the Director, Division of Waste Management, Kentucky Natural Resources and Environmental Protection Cabinet.

Monitoring (full-scan TCL/TAL analyses) of existing ground water monitoring wells and surface waters will occur semi-annually for the first five (5) years after construction is complete and thereafter annually for twenty-five (25) years. Monitoring of leachate treatment effluent will occur according to the plan established and approved by USEPA during the Remedial Design. USEPA may modify the monitoring plan during or after the RD/RA.

#### 9.2.2.2 Clean Air Act (CAA)

The Clean Air Act (CAA) identifies and regulates pollutants that could be released during earth-moving activities associated with the excavation of soils, sediments, and drum wastes of the landfill. The CAA, Section 109, outlines the criteria pollutants for which National Air Quality Standards (NAAQs) have been established. CAA, Section 112, identifies pollutants for which there are no pertinent Ambient Air Quality Standards, those substances regulated under the Federal National Emission Standards for Hazardous Pollutants. The CAA, Sections 109 and 112, is an ARAR and the regulations' standards will be complied with during implementation of the selected remedy. State regulations concerning the release of toxic air emissions, and reflecting pertinent CAA provisions, will also be satisfied.

#### 9.2.2.3 Ground/Surface Water ARARs

Two groups of federal environmental standards and criteria are considered ARARs or TBCs for the surface water at the Smith's landfill: Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) and Clean Water Act (CWA) Ambient Water Quality Criteria (AWQC). The CWA, Section 304, is an ARAR for protection of surface waters relative to the area addressed by Operable Unit Two activities.

State ARARs for the regulation of surface water at the Site which are more stringent than Federal requirements are included in the Kentucky Administrative Regulations, Title 401, Chapter 5:031. Bluelick Creek, and its tributaries which receive drainage from the areas addressed by both Operable Units One and Two, are not specifically listed in the regulations and are, therefore, not location-specific ARARs. However, contaminant-specific surface water quality standards are relevant to Bluelick Creek and its tributaries which provide an intermittent surface water aquatic habitat.

Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act are TBCs. MCLs are the maximum contaminant concentrations allowed in a regulated public water supply and, generally, in sole source ground water systems. These levels apply at the point of distribution ("at the tap") to public water systems having at least fifteen (15) service connections or regularly serving at least twenty-five (25) individuals. Levels are based upon a chemical's toxicity, treatability (including cost considerations), and analytical limits of detection.

MCLs are TBCs at the Smith's landfill, because some small ground water systems near the landfill are currently being used as sources of drinking water, but have not received, and are not expected to receive, contamination from the Site. Hydrogeological investigations reveal localized minor fractures in the shallow compact shale in the general area of the Site. These small, local fracture systems very slowly recharge during significant rain events and supply

small amounts of very low quality ground water to a few shallow wells in the area. Most of the residences in the mobile home park and the surrounding area are on public water, which has as its source the Salt River. A very few residences in the surrounding area obtain their water from either the shallow ground water regime (i.e., from isolated fractures), from cisterns filled with rainwater or trucked water, or from the intermittent streams which run through the stream valley upon which the mobile home park is built. The County is planning to extend public drinking water lines to the few remaining unconnected residences in the area.

The ground water units in the shale strata as well as the ground water units in the deeper limestone aquifer are classified by USEPA as Class III ground water systems. Class III ground water systems either produce water having a suspended solids concentration of at least 10,000 ppm and/or produce only 150 gallons or less per well per day. Class III is subcategorized primarily on the basis of the degree of interconnection with surface waters or adjacent ground water units containing ground water of a higher class. Subclass III B is restricted to ground waters characterized by a low degree of interconnection to adjacent surface waters or ground waters of a higher class within the Classification Review Area. These ground waters are naturally isolated from sources of drinking water in such a way that there is little potential for producing additional adverse effects on human health and the environment. Where hydrogeologic data are available, the Classification Review Area can be subdivided to reflect the presence of naturally occurring, ground water bodies of variable size that may have significantly different use and value. These ground water bodies, referred to as "ground water units", must be characterized by a degree of non-interconnection (between adjacent ground water units) such that an adverse change in water quality to one ground water unit will have little likelihood of causing an adverse change in water quality in the adjacent unit. Each ground water unit can be treated as a separate subdivision of the Classification Review Area. A Classification System decision is made for the ground water unit or units potentially impacted by a specific activity. At the Smith's Farm Site, the ground water units under the area addressed by Operable Unit Two (the landfill and immediately proximal areas) are hydrogeologically isolated from those ground water units under the mobile home park and under nearby residential areas.

The AWQC established under the Section 304 of the CWA are relevant and appropriate requirements at the Site. The AWQC are established for protection of freshwater aquatic organisms. The AWQC will be met at the point the treated leachate discharges to the closest surface water body, i.e., the Unnamed Tributary. Monitoring shallow ground water, upgradient of the surface water body and northeast of the area addressed by Operable Unit One (the MW-21 well cluster), will check compliance with AWQC.

State criteria listed for waters used as a Warm Water Aquatic Habitat (401 KAR 5:031) were more stringent than potential federal ARARs for three (3) contaminants and will be the ARARs for those three (3) contaminants in lieu of the federal AWQC for the same contaminants.

401 KAR 34:020, a State ARAR, involves the construction of a waste facility in a flood-prone area or the potential increase in flooding hazards due to construction in a certain area. The remedial design for the selected remedy will consider on-site flood-prone areas.

Location-specific ARARs will be addressed in the design documents for the selected alternative.

#### 9.2.3 Cost-Effectiveness.

The selected remedy is cost-effective because it has been determined to provide overall effectiveness proportioned to its costs (present worth = \$38,975,000). Table 8.0 compares estimated costs associated with all five (5) alternatives. The selected remedy has a moderate capital cost and O&M costs which are approximately the same as the higher cost Alternatives IV

and V. In Alternatives IV and V the application of treatment processes to the landfill's electromagnetic anomalies do not eliminate the generation of landfill leachate, but merely change the quantities of constituents in the leachate.

#### 9.2.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable.

USEPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner.

Based upon the information presented, the selected remedy will protect surface water and ground water quality by reducing infiltration and leachate production. It provides the best balance among all nine (9) evaluation criteria, with the following being the most important considerations for the Site:

1. Compliance with State and Federal requirements for solid waste landfill closure;
2. Availability of equipment and materials;
3. Cost of construction, O & M;
4. Elimination of rain water infiltration and, thus, reduction in the volume of leachate released, after treatment, to the surface water; and,
5. Continued monitoring to ensure the remedy continues to be protective of human health and the environment.

#### 9.2.5 Preference for Treatment as a Principal Element.

The selected remedy does not satisfy the statutory preference for treatment because treatment of landfill waste, other than leachate, is impractical. The remedy does not include treatment of any contaminated landfill waste matrix. Treatment of the source of contamination (the entire landfill) is technically impracticable, because of the large volume of material, the known heterogeneity of the material, and the low average contaminant concentrations believed to be present. The feasibility of treating isolated, heavily contaminated areas is in question, because the nature and extent of anomalous contamination within the fill area has not been quantified and would be very difficult (and costly) to quantify.

Alternatives IV and V would not provide any additional public health benefit over Alternative III, landfill closure with monitoring (the selected remedy), because existing conditions currently do not pose an immediate, acute risk to human health and the environment and the planned low permeability RCRA-type cap will significantly reduce the generation of leachate. The operation of a leachate collection and treatment system should dramatically reduce the quantity of contaminants migrating to the Unnamed Tributary, and other downgradient areas. The monitoring program that will be implemented as part of this action will detect changes in ground water, surface water, and other media. These data will be reviewed as they are collected, so that if significant degradation in the quality of these media is noted, then further action can be initiated. The effectiveness of the remedy will be reevaluated at least five (5) years after completion of the remedial action.

#### 9.3 DOCUMENTATION OF SIGNIFICANT CHANGES

There were two changes made to the selected remedy from the time the Proposed Plan and the RI/FS Reports were released for public comment to the time of the final selection of the remedy

(CERCLA Section 117(b)). The first change was to require the further investigation, better delineation, and disposal of the surficial metallic anomalies along the Unnamed Tributary from the Operable Unit Two area north to beyond the Operable Unit One area. The second change was made between the time the Proposed Plan was published and the signing of the Record-of-Decision. The requirement for a KPDES (NPDES) permit for the discharge of treated leachate from the leachate treatment system into the Unnamed Tributary was eliminated. According to Section 121(e) of CERCLA, and the NCP, an on-Site discharge does not require a permit; however, the substantive requirements of the CWA, Section 402, NPDES and the corresponding KPDES regulations will be adhered to.

## ATTACHMENT 5.0

Summary Tables of Analytical Results from the Operable Unit Two Remedial Investigation

- 5.3 -- Inorganic Results - Smith's Farm - Operable Unit Two RI Waste Samples
- 5.4 -- Summary of Detected Organic Constituents- Smith's Farm Operable Unit Two RI- Waste Samples
- 5.5a -- Inorganic Results - Smith's Farm - Operable Unit Two RI Leachate Water Samples
- 5.5b -- Summary of Detected Organic Constituents - Smith's Farm Operable Unit Two RI - Leachate Water Samples
- 5.5c -- Summary of Detected Organic Constituents - Smith's Farm Operable Unit Two RI - Leachate Water Samples (Continued)
- 5.6a -- Inorganic Results - Smith's Farm - Operable Unit Two RI Leachate Sediment Samples
- 5.6b -- Summary of Detected Organic Constituents - Smith's Farm Operable Unit Two RI - Leachate Sediment Samples
- 5.6c -- Summary of Detected Organic Constituents - Smith's Farm Operable Unit Two RI - Leachate Sediment Samples
- 5.7a -- Inorganic Results - Smith's Farm - Operable Unit Two RI Surface Soil Samples
- 5.7b -- Inorganic Results - Smith's Farm - Operable Unit Two RI Surface Soil Samples
- 5.7c -- Pesticide/PCB Results - Surface Soil Samples - Smith's Farm - Operable Unit Two RI - Summary of Detected Constituents
- 5.8a -- Summary of Detected Organic Constituents - Smith's Farm Operable Unit Two RI - Surface Soil Samples
- 5.8b -- Summary of Detected Organic Constituents - Smith's Farm Operable Unit Two RI - Surface Soil Samples
- 5.8c -- Inorganic Results - Smith's Farm - Operable Unit Two RI Subsurface Soil Samples
- 5.8d -- Summary of Detected Organic Constituents - Smith's Farm Operable Unit Two RI - Subsurface Soil Samples

## ATTACHMENT 5.1

Analytical data from the sampling of the Unnamed Tributary

## ATTACHMENT 7.0

Summary of Costs for Remedial Actions Alternatives

## ATTACHMENT 7.1

Leachate Collection and Physical Treatment

## ATTACHMENT 7.2

Collection and Chemical/Physical Treatment and Heavy Metals Removal

## ATTACHMENT 7.3

Leachate Collection and Chemical/Physical Treatment for the Removal of Heavy Metals and Organics

## ATTACHMENT 7.4

Leachate Collection and Chemical/Physical/Biological Treatment for the Removal of Heavy Metals and Organics

## ATTACHMENT 7.5

Leachate Interceptor Trench Typical Detail

**ATTACHMENT 8.0**

Letter of Concurrence From  
Commonwealth of Kentucky

COMMONWEALTH OF KENTUCKY  
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET  
DEPARTMENT FOR ENVIRONMENTAL PROTECTION  
FRANKFORT OFFICE PARK  
14 REILLY ROAD  
FRANKFORT KENTUCKY 40601

September 16, 1992

Mr. Tony DeAngelo, Jr.  
SRPM, KY/TN Section NSRB  
Waste Management Division  
U.S. Environmental Protection Agency  
Region IV  
345 Courtland Street, N.E.  
Atlanta, GA 30365

RE: Smith's Farm CERCLA NPL Site  
Brooks, Bullitt County, Kentucky  
Operable Unit Two  
ROD Remedy

Dear Mr. DeAngelo:

The Commonwealth of Kentucky, Department for Environmental Protection has reviewed the proposed remedy contained in the Record of Decision for Smith's Farm, Unit Two. This remedy, which is identified as Alternative 3 in the Feasibility Study, would essentially consist of consolidation and capping of the landfill along with construction of a leachate collection and treatment system. Long term monitoring of the site would continue after the remedy is implemented.

The Commonwealth concurs with the proposed remedy. We look forward to working with you on this site in the future.

Sincerely,

Caroline P. Haight, Director  
Division of Waste Management

COMMONWEALTH OF KENTUCKY  
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET  
DEPARTMENT FOR ENVIRONMENTAL PROTECTION  
FRANKFORT OFFICE PARK  
18 REILLY ROAD  
FRANKFORT, KENTUCKY 40601

June 5, 1992

Mr. Tony DeAngelo, Senior Project Manager  
U.S. Environmental Protection Agency-Region IV  
345 Courtland Street, N.E.  
Atlanta, GA 30365

RE: Smith's Farm, Operable Unit 2 Proposed Plan

Dear Mr. DeAngelo:

We have reviewed the proposed plan for remediation of operable Unit 2 at the Smith's Farm site and believe that, if implemented, it will be a major step forward in the reduction of health and environmental risks. We also recognize EPA's obligation to provide cost-effective solutions for sites on the National Priority List and it is obvious that you have made a painstaking effort to provide such a solution in this case.

It is the position of the Commonwealth of Kentucky (and is clearly stated in the National Contingency Plan) that, where appropriate, engineering controls such as containment must be combined with the treatment of principal threats posed by a site. Therefore, while the Commonwealth endorses capping the landfill and treating leachate, we also believe there must be a concerted effort to identify and treat "hot spots" within the fill.

Our other concern with the proposed plan is that there is no remedial objective for contaminated shallow groundwater. While collection of leachate may resolve this problem, we recommend a contingency plan in the remedial design for pumping and treating of groundwater.

Thank you for the opportunity to provide these comments. We are looking forward to being involved in the remedial design and remedial action at Smith's Farm. Please keep us informed on continuing developments.

Sincerely,

Rick Hogan, Supervisor  
Federal Superfund Section  
Superfund Branch  
Division of Waste Management

RH: kb

COMMONWEALTH OF KENTUCKY  
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET  
DEPARTMENT FOR ENVIRONMENTAL PROTECTION  
FRANKFORT OFFICE PARK  
14 REILLY ROAD  
FRANKFORT, KENTUCKY 40601

September 16, 1992

Mr. Tony DeAngelo, Jr.  
SRPM, KY/TN Section NSRB  
Waste Management Division  
U.S. Environmental Protection Agency  
Region IV  
345 Courtland Street, N.E.  
Atlanta, GA 30365

RE: Smith's Farm CERCLA NPL Site  
Brooks, Bullitt County, Kentucky  
Operable Unit Two  
ROD Remedy

Dear Mr. DeAngelo:

The Commonwealth of Kentucky, Department for Environmental Protection has reviewed the proposed remedy contained in the Record of Decision for Smith's Farm, Unit Two. This remedy, which is identified as Alternative 3 in the Feasibility Study, would essentially consist of consolidation and capping of the landfill along with construction of a leachate collection and treatment system. Long term monitoring of the site would continue after the remedy is implemented.

The Commonwealth concurs with the proposed remedy. We look forward to working with you on this site in the future.

Sincerely,

Caroline P. Haight, Director  
Division of Waste Management

CPH/RH/kb

c: Carl Millanti  
Farough Fakharpour

## ATTACHMENT 9.0

### Determination of Remediation Levels in Tables 9.0 a & b & C

#### DETERMINATION OF REMEDIATION LEVELS IN TABLES 9.0a, 9.0b, 9.0c

Remediation levels for individual constituents were determined by balancing acceptable, desirable risk levels (noncarcinogenic and carcinogenic) with Contract Required Detection Limits (CRDLs) or Contract Required Quantitation Levels (CRQLs) so that remediation levels were significantly below the Exposure Point Concentrations (EPCs). The formulae on pages 3-30, 3-33, 334, 3-39 and 3-40, and Appendix C, of the Risk Assessment, Volume III of the Remedial Investigation Report, were used to calculate Remediation Levels from Desired Risk Levels and vice versa. Medium Soil/Sediment CRDLs for Pesticide/PCB TCL compounds were defined by the PRP laboratory as being 15 times the individual Low Soil/Sediment CRDL. Medium Soil/Sediment CRDLs for SemiVolatile TCL compounds were defined as being 60 times the individual Low Soil/Sediment CRDL. The difficulty of analyzing samples at both the Low and Medium CRDLs was recognized. Originally, back calculations utilized those PRP lab CRDLs. However, Contract Required Quantitation Limits (CRQLs) from the Exhibit C addendum to the USEPA Region IV ECBSOPQA Manual were eventually utilized. The adjustments of risk level relative to those CRQLs was accomplished by relating the risk contribution of an individual constituent to a specific pathway. Standard CRQLs from Exhibit C were used for Target Compound List (TCL) compounds and standard CRDLs from Exhibit C were used for Target Analyte List (TAL) compounds. As a practical matter, one has to be able to assure detection and quantitation of a constituent before one can assign a risk to that concentration relative to a specific pathway. Numbers have been rounded where appropriate.

#### EXHIBIT C

##### TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

NOTE: The values in these tables are quantitation limits, not absolute detection limits. The amount of material necessary to produce a detector response that can be identified and reliably quantified is greater than that needed to simply be detected above the background noise. The quantitation limits in these tables are set at the concentrations in the sample equivalent to the concentration of the lowest calibration standard analyzed for each analyte.

Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

The CRQL values listed on the following pages are based on the analysis of samples according the specifications given in Exhibit D. For each fraction and matrix, a brief synopsis of the sampling handling and analysis steps is given, along with an example calculation for the CRQL value. All CRQL values are rounded to two significant figures. For soil samples, the moisture content of the samples is not considered in these example calculations.

Note that the CRQL values listed on the preceding page may not be those specified in previous CLP Statements of Work. These values are set at concentrations in the sample equivalent to the concentration of the lowest calibration standard specified in Exhibit D VOA. Lower quantitation limits may be achievable for water samples by employing the Statement of Work for Low Concentration Water for Organic Analyses.

#### VOLATILES

##### Water Samples

A 5 mL volume of water is purged with an inert gas at ambient temperature. The volatiles are trapped on solid sorbents, and desorbed directly onto the GC/MS. For a sample with compound X at the CRQL of 10 ug/L:

$(10 \text{ ug/L}) (5 \text{ mL}) (10^{-3} \text{ L/mL}) - 50 \times 10^{-3} \text{ ug} - 50 \text{ ng}$  on the GC column

#### Low Level Soil/Sediment Samples

A 5 g aliquot of the soil/sediment sample is added to a volume of water in a purge tube, heated, and purged with an inert gas. The volatiles are trapped, and later desorbed directly onto the GC/MS. For a sample with compound X at the CRQL of 10 ug/Kg:

$(10 \text{ ug/Kg}) (5 \text{ g}) (10^{-3} \text{ Kg/g}) - 50 \times 10^{-3} \text{ ug} - 50 \text{ ng}$  on the GC column

#### Medium Level Soil/Sediment Samples

A 4 g aliquot of soil/sediment is extracted with 10 mL of methanol, and filtered through glass wool. Only 1 mL of the methanol extract is taken for screening and analysis. Based on the results of a GC/FID screen, an aliquot of the methanol extract is added to 5 mL of reagent water and purged at ambient temperature. The largest aliquot of extract considered in Exhibit D is 100 uL. For a sample with compound X at the CRQL of 1200 ug/Kg:

$(1200 \text{ ug/Kg}) (4 \text{ g}) (10^{-3} \text{ Kg/g}) - 4800 \times 10^{-3} \text{ ug} - 4800 \text{ ng}$

This material is contained in the 10 mL methanol extract:

$(4800 \text{ ng}) / 10 \text{ mL} - 480 \text{ ng/mL}$

Of which, 100 uL are purged from the reagent water.

$(480 \text{ ng/mL}) (100 \text{ uL}) (10^{-3} \text{ mL/uL}) - 480 \times 10^{-1} \text{ ng} - 50 \text{ ng}$  on the GC column

Note that for both low and medium soil/sediment samples, while it may affect the purging efficiency, the volume of reagent water used in the purging process does not affect the calculations.

#### SEMIVOLATILES

##### Water Samples

A 1 L volume of water is extracted in a continuous liquid-liquid extractor with methylene chloride at a pH of approximately 2. This extract is reduced in volume to 1.0 mL, and a 2 uL volume is injected onto the GC/MS for analysis. For a sample with compound X at the CRQL of 10 ug/L:

$(10 \text{ ug/L}) (1 \text{ L}) - 10 \text{ ug}$  in the original extract

When the extract is concentrated, this material is contained in the 1 mL concentrated extract, of which 2 uL are injected into the instrument:

$(10 \text{ ug/mL}) (2 \text{ uL}) (10^{-3} \text{ mL/uL}) - 20 \times 10^{-3} \text{ ug} - 20 \text{ ng}$  on the GC column

##### Low Soil Samples

A 30 g soil sample is extracted three times with methylene chloride/acetone at ambient Ph, by sonication. The extract is reduced in volume to 1.0 mL, and a 2 uL volume is injected onto the GC/MS for analysis. For a sample with compound X at the CRQL of 330 ug/Kg:

$$(330 \text{ ug/Kg}) (30 \text{ g}) (10^{-3} \text{ Kg/g}) - 9900 \times 10^{-3} \text{ ug} - 9.9 \text{ ug}$$

When the sample extract is to be subjected to Gel Permeation Chromatography (required) to remove high molecular weight interferences, the volume of the extract is initially reduced to 10 mL. This 10 mL is put through the GPC column, and only 5 mL are collected off the GPC. That 5 mL volume is reduced to 0.5 mL prior to analysis. Therefore:

$$(9.9 \text{ ug}/10 \text{ mL}) (5 \text{ mL}) - 4.95 \text{ ug}$$

This material is contained in the 0.5 mL extract, of which 2 uL are injected into the instrument:

$$(4.95 \text{ ug}/0.5 \text{ mL}) (2 \text{ uL}) (10^{-3} \text{ mL/uL}) - 1.98 \times 10^{-2} \text{ ug} \text{ } 20 \text{ ng on the GC column}$$

#### Medium Soil Samples

A 1 g soil sample is extracted once with 10 mL of methylene chloride/acetone, which is filtered through glass wool to remove particles of soil. The filtered extract is then subjected to GPC clean up, and only 5 mL of extract are collected after GPC. This extract is reduced in volume to 0.5 mL, of which 2 uL are injected onto the GC/MS. For a sample with compound X at the CRQL of 10,000 ug/Kg:

$$(10,000 \text{ ug/Kg}) (1\text{g}) (10^{-3} \text{ Kg/g}) - 10 \text{ ug}$$

This material is contained in the 10 mL extract, of which only 5 mL are collected after GPC:

$$(10 \text{ ug}) (5 \text{ mL}/10\text{mL}) - 5 \text{ ug}$$

The volume of this extract is reduced to 0.5 mL, of which 2 uL are injected into the instrument:

$$(5 \text{ ug}/0.5 \text{ mL}) (2 \text{ uL}) (10^{-3} \text{ mL/uL}) - 20 \times 10^{-3} \text{ ug} - 20 \text{ ng on the GC column}$$

Eight semivolatile compounds are calibrated using only a four point initial calibration, with the lowest standard at 50 ng. Therefore, the CRQL values for these eight compounds are 2.5 times higher for all matrices and levels.

#### PESTICIDES/AROCLORS

#### Water Samples

A 1 L volume of water is extracted three times with methylene chloride or by a continuous liquid-liquid extractor. This extract is reduced in volume to approximately 3-5 mL, and diluted up to 10.0 mL with clean solvent. When Gel Permeation Chromatography is performed, only 5 of the 10 mL of extract are collected after GPC.

Regardless of whether GPC is performed, either 1.0 or 2.0 mL of the 10.0 mL of the original extracts are taken through the remaining clean up steps (Florisil and sulfur removal). The volume taken through Florisil cleanup and the final volume of the extract after the clean up steps depends on the requirements of the autosampler. If the autosampler can handle 1.0 mL final extract volumes, this is the volume taken through Florisil and the final volume. If the

autosampler cannot reliably handle 1.0 mL volumes, the volume is 2.0 mL. When using an autosampler, the injection volume may be 1.0 or 2.0 uL. Manual injections must use a 2.0 uL injection volume.

For a sample with compound X at the CRQL of 0.05 ug/L and an autosampler requiring a 1.0 mL volume:

$(0.05 \text{ ug/L}) (1 \text{ L}) = 0.05 \text{ ug}$  in the original extract

This material is contained in the 10.0 mL of extract:

$(0.05 \text{ ug}) / (10.0 \text{ mL}) = 0.005 \text{ ug/mL}$

Of which, only 1.0 mL is carried through the remaining clean up steps. For a final extract volume of 1.0 mL and a 1 uL injection volume:

$(0.005 \text{ ug/mL}) (1 \text{ uL}) (10^{-3} \text{ mL/uL}) = 5 \times 10^{-6} \text{ ug} = 5 \text{ pg}$  on the GC column

#### Soil Samples

There is no differentiation between the preparation of low and medium soil samples in this method for the analysis of pesticides/Aroclors. A 30 g soil sample is extracted three times with methylene chloride/acetone by sonication. The extract is reduced in volume to 10.0 mL and subjected to GelPermeation Chromatography. After GPC, only 5.0 mL of extract are collected. However, as with the water sample described above, either 1.0 or 2.0 mL of that extract are subjected to the other clean up steps, so no loss of sensitivity results from the use of GPC. From this point on, the soil sample extract is handled in the same fashion as the extract of a water sample. For a sample with compound X at the CRQL of 1.7 ug/Kg:

$(1.7 \text{ ug/Kg}) (30 \text{ g}) (10^{-3} \text{ Kg/g}) = 51 \times 10^{-3} \text{ ug} = 51 \text{ ng}$  in the original extract

This material is contained in the 10.0 mL of extract:

$(51 \text{ ng}) / 10 \text{ mL} = 5.1 \text{ ng/mL}$

Of which, only 1.0 or 2.0 mL are carried through the remaining cleanup steps. For a final extract volume of 1.0 mL and a 1 uL injection volume:

$(5.1 \text{ ng/mL}) (1 \text{ uL}) (10^{-3} \text{ mL/uL}) = 5.1 \times 10^{-3} \text{ ng} = 5 \text{ pg}$  on the GC column.

For either water or soil samples, if the autosampler used requires a 2.0 mL final volume, the concentration in the 10.0 mL of extract above remains the same.

Using a 2 uL injection volume, twice the total number of picograms are injected onto the GC column. However, because the injection volume must be the same for samples and standards, twice as much material is injected onto the column during calibration, and thus the amount of compound X injected from the sample extract is equivalent to the amount of compound X injected from the calibration standard, regardless of injection volume.

If a single injection is used for two GC columns attached to a single injection port, it may be necessary to use an injection volume greater than 2 uL.